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# culture

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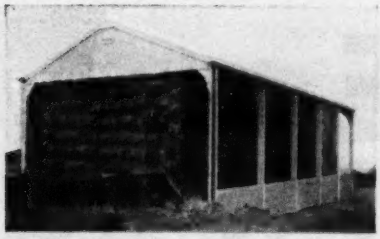

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# Agriculture

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CONTENTS

# The crisp that cost Fisons hundreds of pounds

**Crisp manufacturers prefer potatoes containing a high amount of dry matter.** So the farmer who can produce them will find an easier market—and often get a better price. '*Sulphate of potash*', says the Fisons recommendation book, '*consistently gives slightly higher dry matter content than muriate.*'

A simple enough statement. But notice the word 'consistently'. Then think what lies behind it. Not just one experiment. That could be affected by one year's weather. Or by some soil peculiarity. It needed experiment after experiment. In different years, in different conditions. In the end it took six years and hundreds of pounds' worth of research. The result was a second fertilizer for potatoes in arable systems: Fisons High-K 51 with sulphate of potash. This is one aspect of Fisons research—**but more important still is their work on the main plant food requirements of potatoes.**

In arable rotations, potatoes need a high rate of fertilizer nitrogen. 130 units per acre is a normal figure. *But do they need the same amount when they are grown after grass?* Fisons set out to collect all the necessary evidence. And indeed they found that potatoes in a ley rotation may need no more than 80 units per acre. *But they also learned something much more interesting.*

Too high a rate of nitrogen proved to be more than just a costly waste of fertilizer. It could actually reduce yields and spoil the quality of the potatoes. The answer was a completely new fertilizer for ley-farming rotations: Fisons 50 (10.15.20).

**These are just two of the practical results of work at Levington Research Station. Both illustrate the care and research that go into all Fisons recommendations. And both show how these recommendations can be measured in terms of real profit—for every farmer.**

# The Poultry Health Scheme

THE first of January, 1966, saw the introduction of the Poultry Health Scheme which is in essence a continuation of the disease control aspects of the Ministry's former Poultry Stock Improvement Plan and of the Scottish Poultry Improvement Scheme. Although the new scheme was built on an existing foundation, a great deal of consultation and preparation was necessary before it could be introduced.

Participation in the new scheme is both voluntary and free. The scheme is a national one, but for administrative purposes it is run in England and Wales by the Animal Health Division of the Ministry and in Scotland by the Animal Health Branch of the Department of Agriculture and Fisheries. The object of the scheme is the establishment and maintenance of healthy sources of poultry stock, and members are offered:

(a) veterinary investigation of all disease problems;

(b) routine blood testing for pullorum disease;

(c) a post-mortem diagnostic service.

Membership is open to breeders with a minimum number of breeding stock and to hatchery owners with a minimum incubator capacity provided they can comply with the necessary standards for premises, management, disease control and health. There has been an encouraging response to the scheme, particularly from members of the previous schemes. There is an added incentive for owners to join if they are engaged in exporting poultry: many countries insist that imported stock must originate from flocks participating in a government-controlled scheme. A booklet about the scheme was sent to all members of the previous schemes and other interested parties. Copies of this booklet and further information can be obtained from the Ministry's divisional veterinary officers.

A. KELLY

# The Storage and Use of Moist Barley for Milk Production

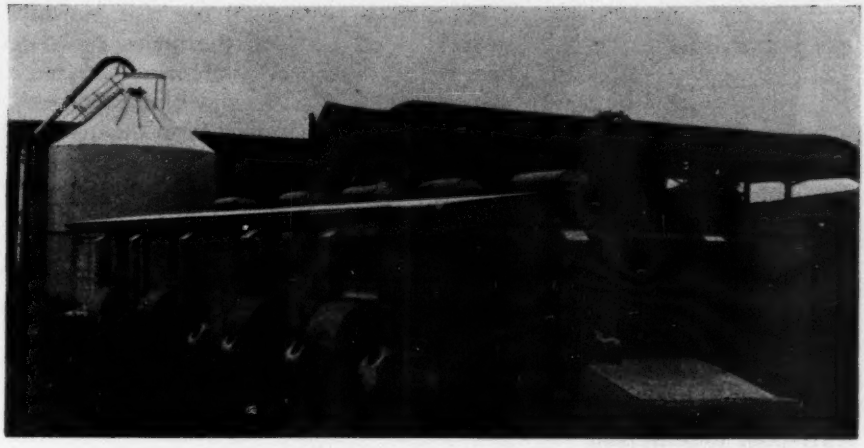
by I. J. C. Friend

As the first farmer in this country to develop the sealed storage of moist barley for milk production, I know the difficulty of explaining to other farmers that my system is based on Samuel Brody's bioenergetic concept of 'the feed efficiency complex'. In this article I have attempted to set out in simple terms the essentials. The economic argument rests on K. L. Blaxter's finding to the effect that voluntary intake in cows rises 20 per cent for every 10 per cent gain in food quality. The system also makes use of the fact that a cow's barley feed needs to be moist and sweet, not dry and dusty. In moist barley feeding trials my pedigree British Friesian cows ate about 55 lb of dry matter and up to 60 lb of barley daily, with excellent, fast-moving rumen function using about 5 lb of hay or straw. On dry feeding the accepted level is about 30 lb of dry matter. Grain drying will slash the amount of starch which the animal can comfortably consume to such an extent that the amount of the total ration diverted to unproductive maintenance needs becomes disproportionately high. The main cost of grain drying is only measured in terms of lost animal production potential.

In the light of the work of Drs. Singsen and Scott, who produced their maize-based high-energy broiler ration at Connecticut in 1948 which allowed the broiler industry to take off, it became apparent to me that a similar system of *ad lib.* high-energy feeding for milk and beef might be formulated from barley stored in a semi-fermented condition with fish meal, vitamin and mineral supplements.

## The techniques of storage

The Food and Agriculture Organisation estimates that 25 per cent of the world's grain harvest is consumed in storage by rodents, moulds and insects. One reason is because traditional bin and floor storage methods offer no physical barrier to mould or insect growth, as does an atmosphere containing about 80 per cent carbon dioxide which develops naturally in about a week after grain of about 20 per cent moisture content is stored



*Welded steel grain silo and environment-controlled cattle house on the author's farm at Winnington Grange*

in a fully-sealed silo. Moulds are more sensitive to a lack of oxygen than they are to dessication, freezing or chemical control. When moist grain is first put into a sealed silo and the hatch covers are screwed on, the moulds grow until the lack of oxygen inhibits further growth and then the natural yeasts develop which give the characteristic 'near-beer' smell.

From my own experience, I would say that the first essential for moist grain storage is to use a welded sealed silo. The second essential of a sealed grain silo, in my view, is that it must have a steel base plate to stop damp and air rising through the concrete and causing unloading problems through secondary moulding of the grain. Using a welded sealed silo, I have been able to keep barley at 23 per cent moisture for two years with no deterioration at all. As the normal pH value of moist grain is around neutral, there is no need for any anti-acid lining.

## Loading and unloading

We use a flexible auger for unloading. Using a fully-sealed welded silo we have not needed a sweep-arm auger or trident outlets, but the manufacturers of semi-sealed tower silos advise them, presumably to help overcome the bridging effects caused by secondary moulding. As the settling angle of moist grain is steep at about 38 degrees, steeply-coned roofs are needed or top spreaders must be used to allow silos to be topped up.

To fill our silos we use a blower operating at 780 revolutions per minute, not 540 as for silage. An important point to note is that grain must be tipped along the line of the auger into the hopper bottom and not across the line. The loading rate of a ton a minute avoids any bottlenecks even if several big combines are being used to fill a silo. We do not clean the grain except by crop spraying.

At harvesting time the grain is combined at the binder stage before the heads are brittle enough to blow off; we find that this both increases dry matter yields and improves the quality of the straw for feeding. Early harvesting helps to avoid any build up of wild oats. More days can be worked by each combine and more hours per day. The number of combines on a farm, which is one to about ninety acres of corn in Britain, can be reduced

once grain drying is given up. We aim to average 20 per cent moisture content, which means a range of 15–24 per cent. At the higher moisture levels combining is slow and often wasteful. Using a combine, a man and a boy should be able to harvest 600 to 1,000 tons of grain, without the costs, stresses, night-work and dust of grain drying. On a stock-farm the question must be asked: is your grain drying really necessary or is it all hot air? The fact has to be faced that about 80 per cent of all the grain grown in Britain is fed to livestock and needs to be stored moist.

At an all-in capital cost of £4 to £5 per ton stored after deducting farm improvement grant but including all handling equipment, a syndicate of farmers might well consider putting up a 600-ton silo, even if they have to buy barley at £18 a ton undried at harvest time. An individual silo of 110-ton capacity costs about £1,000 inclusive of all equipment.

## Low-cost production

Last year the margin over all feed and labour under the Milk Marketing Board's Scheme on my farm at Winnington Grange worked out at about £97 10*s.* per cow in a hundred-year-old cowshed, which indicates that Britain can produce milk very competitively at present-day prices. In 1965 barley yields were about two tons an acre, which was up to the ten-year average on 345 acres. The amount of conserved roughages is cut down, both to allow the level of digestibility in the rumen to be kept up to 75 per cent or more and to allow a higher proportion of the grass crop to be grazed so that returns per acre are high. A stocking rate of two cow equivalents per acre of grass can be achieved. Land used for dairying can earn profits to match modern land values with this system. Barley straw can be used as the main source of roughage, which need not exceed 7 lb daily for good dairy cows. Large quantities of vitamin A and iodine are fed to our barley beef animals to control blindness, coughing and liver troubles. After ten years of barley beef production in a closed herd, the benefits from a minimal disease programme cannot be over-stressed.

It should be emphasized that we feed our cows on good grass in season, and not on barley alone. Using 150 acres of grass, of which half is unploughable and inaccessible, the 1965–6 stocking was 110 milking cows, 80 heifers and 320 breeding ewes with their lambs. In recent years only one cow has been barren and she had given over 50 tons of milk. Barley is used at 2·7 lb per gallon sold or 21·9 cwt per cow, but this barley keeps roughage costs down to 1·5*d.* per gallon so it really contributes considerably to maintenance needs. Barley is always costed against the cows at market value. The shelf life of moist barley is about two or three months in winter, and surpluses are bought and sold readily. The high palatability and the complete absence of acetonaemia are noteworthy. A fishmeal, vitamin, mineral concentrate additive is used with the barley; 10 per cent for cows and calves, and 5 per cent for beef and heifers.

At the present time, some farmers are finding that systems of winter feeding based on conserved grass and slurry are losing their charm. We gave up non-effluent wilted silage after seven years on the grounds that it took up too much highly-capitalized space in the stomachs of the cows in proportion to the combustible energy it provided. Over the past ten years, according to Bristol University, the cost of growing starch in Britain as barley has come down 4 per cent per year and grass starch costs have gone

*The interior of the cattle house*

up 7½ per cent per year. Whereas barley used to provide starch at 50 per cent more cost than grass, the positions have now been reversed. Cost-literate farmers have to ask themselves: is grass the cheapest source of starch on my farm? The term 'margin over concentrates' has lost its meaning and is often used to cover up the high cost of conserved roughages. Concentrated feeds, as well as concentrated nitrogenous fertilizers, usually offer the best unit value with present-day transport and labour costs. With respect, blunt management tools such as 'gross margins' and 'margin over concentrates' are no substitutes for sharp pencils and personal supervision with weekly milk recording and full feed recording of individual cows.

As about 60 per cent of the cost of milk production is food cost, feed conversion efficiency is the key to lower costs, not labour, which is secondary. Labour may well be the major worry but is never the major cost. It is all too easy to automate feeding and create a capital problem to replace a labour problem. In November, 1965, it paid to feed 5 lb of concentrates per gallon to achieve a 2*s.* a gallon margin over all feed and labour. It is difficult, but very rewarding to achieve a high level of interest in feeding costs amongst all the staff. The broiler industry, with its high-input/high-output philosophy of feeding, has helped to reorientate ideas on low-cost milk production. Nobody feeds a broiler chicken a maintenance ration of roughage; so why stuff it into the cow? A relatively incombustible feed such as hay, which has died a lingering death with heavy loss of digestible nutrients in the field, cannot be expected to act as a 'tiger in the tank'. For that matter no car owner puts a proportion of vaporizing oil in his car's tank to lower cost per mile. The practice of feeding a maintenance ration to cows which was rich in fibre and low in energy grew up largely to safeguard the cow against digestive disturbance and death from eating industrial wastes, dessicated grain, oil seeds and millers' offals. Today, with tailor-made concentrated rations, no such waste of digestive space need occur. The idea of feeding a fibrous bulky maintenance ration with a concentrated ration for production is obsolete in winter and summer alike.

The work on grass digestibility at the Grassland Research Institute shows that grass can now be regarded as a concentrate at certain seasons, while barley may well be used for maintenance to exploit an animal's potential for milk production when milk prices are high. There is no incompatibility between barley and grass if the dairy farmer has got the up-to-the-minute

costs on which to base his weekly feed programme. The object is to use the digestive space to full advantage and to speed up the rumen's throughput by improving food quality. The theory is that, as long as distension and digestive discomfort in the ruminant can be controlled, the physical and economic levels of energy intake are set at a very high level.

After ten years of feeding barley to the complete exclusion of other cereals and oil cakes, no snags whatever have cropped up to suggest that the scientific theories of K. L. Blaxter do not work out in practice. Apart from the adverse logistics of handling conserved grass, which only flows reluctantly and expensively, grass and conserved grass are never likely to offer the high-yielding cow a well-standardized feed. This lack of standardized consistency throws an intolerable burden on those of us who manage grass for high digestibility. Barley lends itself to standardization. Dr. Blaxter agrees with my contention that the levels of mineral and vitamin requirements vary little with the class of stock or their level of production. To quote his words, 'The main determinant of production level is how much biologically useful energy can be got into the animals'.

## Further progress

Much opportunity for further advances lies in the fact that the ruminants, unlike animals with simple stomachs, do not match their energy intake primarily to energy requirements. In order to maximize the return from the scarce resources of land, labour and capital, the practice of calving heifers at 24 months of age after rearing them as barley beef for their first winter has worked well. The change from one high-energy diet to another, on turning out in the spring, is less abrupt than a change from a low- to a high-energy diet or the reverse. This early calving practice, giving a tidy calving pattern over the years, reduces the capital and land devoted to young stock by almost half. All our heifers are self-fed from hoppers with moist barley and 5 per cent concentrate additive when housed. The great advantage of hopper feeding which is a major advance on auger feeding is that no week-end feeding of young stock need be carried out, and there are no moving parts or motors to go wrong as with auger feeding. Press-button feeding systems usually represent poor use of capital in Britain, where capital is usually dearer than labour. The reason why Britain can use hoppers is that moist barley husk, when hammer-milled or rolled, breaks into long resilient strips instead of being reduced to the consistency of sawdust, and can provide a diet for ruminants which does not require added roughage such as the Americans need to supply with maize. We hammer-mill our moist barley for all stock.

The livestock engineering revolution requires the farmer to back his judgment with a lot of capital at risk, personal management and sustained effort. With structural reform, technological enterprise and incentives from higher profit retentions, many family farming businesses could operate as closed private companies with conspicuous success to help achieve the objectives of the National Economic Development Plan. In agriculture, the opportunities lie in cutting down grass conservation to allow heavier stocking. Much of the work of pioneering new methods has been undertaken in the past by the professional core of successful large farmers trading through closed companies. It is to be hoped that these men will be able to continue their work.

At a time when some systems of milk production are not very profitable, it can be shown that my net return on capital employed has been sufficient to give a one-for-four scrip issue in each of the past ten years. Such figures can bring a smile to the face of any bank manager, but no milk producer underestimates the toil, tears, sweat and blood involved in achieving good profits from milk. The aged, the infirm and the amateurs are finding the going very hard, while it is significant that most large herds in Britain are in the hands of younger men trained and practised in the manifold new technologies of milk production. In my own case, fourfold expansion from retained profits has been possible in the past five years and the opportunities ahead look encouraging.

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The author of this article, **I. J. C. Friend, M.A.,** farms at Winnington Grange, Market Drayton, Shropshire. He was formerly on the staff of the Milk Marketing Board, and has pioneered the use of moist barley for milk production in this country.

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**9th INTERNATIONAL CONGRESS OF ANIMAL PRODUCTION**
**EDINBURGH: 11th—18th AUGUST, 1966**

THE programme of this Congress covers scientific and practical aspects of animal production, with 35 invited papers and 133 short, contributed papers. The former cover nine topics, centred round the theme 'Intensive animal production', and include problems of environment and disease, the integration of supply, production and marketing, the grazing animal in relation to its environment, and problems of production in mountain and hill regions. Other topics deal with the work of the Animal Breeding Research Organisation, carcass evaluation, energy requirements in relation to the levels of other nutrients, and the relevance of laboratory animal experiments to the genetic improvement of farm livestock.

Visits will be paid to research farms and to various commercial enterprises during the Congress and there is a full programme of social activities. Full details can be obtained from the Congress Office, 5 Hope Park Square, Edinburgh, 8.

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# Mastitis Control

C. D. Wilson

WHILE considerable progress has been made in the control and even the eradication of many diseases which were responsible for serious losses both in livestock and productive ability, bovine mastitis still remains a serious problem not only in Britain but in all the dairying countries of the world. It has been calculated that the losses arising from mastitis in Britain are £20 million a year and $230 million in the United States of America.

It was believed that the advent of antibiotics for treatment would mean a big reduction in the importance of the disease, but this has not proved to be the case although antibiotics are the best available means of producing both a clinical and a bacteriological cure of clinical mastitis. But only too often inadequate treatment has been given, with the result that, while the clinical symptoms disappear temporarily, the infection is not eradicated and a further attack of clinical mastitis occurs within a few weeks.

Resistance on the part of the causative organisms to the various antibiotics has increased. This is particularly true of haemolytic staphylococci (the organisms most frequently associated with mastitis) in respect of penicillin. Over 70 per cent of the strains of staphylococci recovered from clinical mastitis in Britain are resistant to penicillin as a result of the suppression of sensitive strains and the increase in resistant strains to take their places. There is also an increase in the number of resistant strains of organisms to other antibiotics. This is true not only of staphylococci, but also of streptococci.

When it is considered that these antibiotics may be harmful to human beings if they are present in milk and may interfere with the manufacture of cheese and yoghourt by inhibiting the starter organisms necessary for these processes, it is evident that indiscriminate treatment of cows with antibiotics should be discouraged.

After a preliminary period of testing producers' milk for the presence of inhibitory substances, mainly antibiotics, the Milk Marketing Board are going to introduce a price reduction scheme from 1st April. This means that, after a preliminary warning, any producer's milk which fails the test will be subject to a reduction of 1*s*. a gallon. Since last June, most manufacturers have labelled their intra-mammary products with the time that the milk

from a cow should be withheld from the bulk supply after intra-mammary treatment. If these instructions are strictly observed, there will be no danger of milk failing the test.

There is, therefore, a strong case for keeping close control of the use of antibiotics in the treatment of mastitis and for more radical measures to be applied than the treatment of each clinical case. It is for this reason that work has been carried out at the Central Veterinary Laboratory, Weybridge, and at other research centres to find out the sources of the various organisms which are associated with mastitis and to discover how these infections gain access to cows' udders.

Studies have also been made to see whether it is possible to prevent specific infections from establishing successfully in the udder—chiefly by the use of vaccines. The possibility of eradicating various infections by the treatment of all infected cows has also been examined, and finally, attempts have been made to evolve a system of cow management which will prevent, or reduce considerably, the spread of infection from cow to cow.

## Vaccination

Vaccines play an effective part in the control of many animal diseases. Brucellosis, for instance, has been well controlled in this way. However, there are many organisms associated with mastitis and it is not possible to produce a vaccine which will protect against all the possible forms, and even a vaccine produced against a specific infection will only give limited protection, by reducing the severity of clinical mastitis. It will not prevent the udder becoming infected nor the development of subclinical mastitis. The latter is a low-grade form of mastitis which produces no obvious alteration in the udder or the appearance of the milk, but does result in an increase in the cell-content of the milk. It is the most common form of mastitis, and since it results in a 10 per cent loss of milk-yield in an affected lactation, it is also the most important economically.

## Eradication

When mastitis results from infection with *Str. agalactiae*, it is possible to eradicate the disease. *Str. agalactiae* was the main cause of mastitis before the last war, and is still of importance since about 15 per cent of cattle in Britain carry this infection on their udders. It is peculiar amongst the organisms associated with mastitis in that it is largely confined to the udder, and is not found in other animals. Being sensitive to penicillin, the treatment of all cases in a herd can lead to its eradication.

At one time all infected cows were treated at the same time whether they were in milk or dry and, where only a few cows are infected, this is still the best method. However, if there is a large number of infected cows in the herd, treatment while they are in milk means serious financial loss to the farmer because the milk from treated cows cannot be sold for 4–6 days.

It has now become the practice to treat the cows as they go dry. This is a very suitable time, since the penicillin carries out a dual function of removing the established *Str. agalactiae* infection and acting as a preventative to summer mastitis. If treatment is applied in the dry period, all newly-calved cows should be milked first or adequate precautions must be taken to prevent transfer of infection from cow to cow during milking. These will be described later.

Eradication of other mastitis infections is not so easy because they are much more widespread in nature, are found on the skin of the udder and in other parts of the cow, and frequently are much more difficult to treat. This is so because the organisms are either resistant to antibiotics or are protected against their action in deep-seated lesions in the udder.

## Control by hygiene

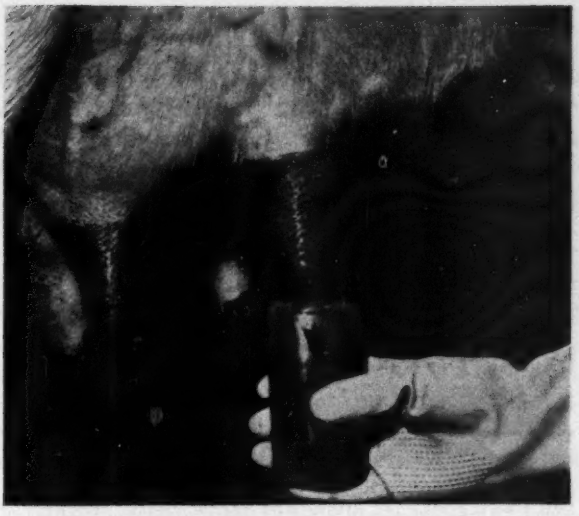
Since it is not possible to immunize cattle successfully against mastitis or to eradicate most infections, and since the indiscriminate use of antibiotics has its dangers, the best hopes of success in combating mastitis lie in the method of preventing infection from invading the udder. Prevention is undoubtedly better than cure. In a series of experiments at the Central Veterinary Laboratory, it has been shown that infection is spread from cow to cow almost entirely during milking and that the infection enters the udders through the teat-canals. It has also been shown that staphylococci and some species of streptococci can become established on the skin of the udder and teats. It was also demonstrated that the spread of mastitis infection from diseased to healthy udders could be prevented almost entirely by ensuring that the milkers' hands, the udder-cloths and the teat-clusters were not carrying infection when approaching a cow to be milked.

This result can be achieved in various ways. Hands are notoriously difficult to disinfect, particularly if they are affected with sores or chaps, and in any case are frequently sensitive to strong disinfectants or detergents. Therefore, all milkers should wear rubber gloves and dip their hands in a suitable disinfectant before each occasion that they have to handle the udders during milking.

Sterilized individual udder-cloths or disposable paper towels should be used to wash the udder before milking, using a suitable disinfectant. The cluster can be disinfected either by running cold water through it, via the long milk-tube, for 15 seconds or by sucking hot water (85°C) through it for 6 seconds.

Finally, because the infection is present on the skin of the teat, after each cow is milked the teats should be dipped in a strong solution of an

*Portable device for heat treatment of milking machine clusters*



*Dipping the teats in disinfectant after milking*

iodophor (5,000 p.p.m. of available iodine). In this way any infection which has accumulated round the teat-orifice or in the lower part of the teat-canal is dealt with.

This is a fairly laborious routine, and recent work at the National Institute for Research in Dairying suggests that disinfection of the teat clusters after each cow is milked does not produce a much better result than where no such treatment is applied. Further experiments need to be carried out to establish the true value of each step in the hygiene routine during milking.

## Culling

It must be recognized that certain cows are so badly affected that they are incurable. Culling of these cows should be carried out at the earliest possible moment. Where practicable they should be milked last while they are still present in the herd.

There will always be some mastitis present in a herd and clinical cases must be treated promptly and effectively. It is better to treat sub-clinical mastitis cases in the dry period so that the risk of antibiotic contamination of the milk is reduced. However, it has been established beyond doubt that bovine mastitis is an infectious disease which is spread from cow to cow during milking and that new infections can be reduced considerably if an adequate system of hygiene is practised.

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This article has been contributed by **C. D. Wilson, M.R.C.V.S.**, who is a Senior Research Officer in the Bacteriology Department of the Central Veterinary Laboratory, Weybridge. Mr. Wilson has been engaged for some years on a special study of the problems associated with mastitis.

# Poultry Manure Disposal —Is There A Problem?

**by C. T. Riley**

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POULTRY batteries spew out muck daily, weekly, throughout the year. It is heavy, it sticks to implements, it smells and the smell sticks to humans; it scents the fields and one senses that in this day and age both master and man are just a little ashamed of either having it or knowing of it. How can one speak of 'muck' in this era of controlled environment and computers? Our fathers spoke of muck and of money in the same breath, and some made quite a lot of money, but they rarely had problems with muck because they used it. It is perhaps significant that only the most highly-developed countries have muck disposal problems! In truth, there is only one problem with muck, it is just not fashionable any more. It is far easier to say 'it's cheaper to use artificials' than to attack the problem. The fact is that among all concerned, whether on the farm or off, nobody is very interested.

About a year ago the N.A.A.S. started to look at the poultry manure problem and we recently finished a survey of some 170 farms covering a million-and-a-half layers on some 20,500 acres. The object was to get some facts and to see whether our preliminary assumptions were sound. As usual we found some things that we were not expecting. The main surprise was a difficulty over the country as a whole in finding farms that really had a poultry manure disposal problem. Clearly, the problem farm is associated more with certain regions than others, but we did not find as many problem farms as expected. The difference between a problem farm and a no-problem farm is not at all easy to measure. There is a relationship with acreage but this is not absolute and the same applies to birds per acre. It is the imponderable factors, such as smell and the sort of people who smell the smells, that put a farm into the problem or no-problem grouping. Environment in its broadest sense defines the difference between a problem and a no-problem farm.

In looking at these farms we recorded cattle and pigs, and estimated muck from other livestock as well as that produced from poultry. It is not always realized how many farms with poultry carry substantial numbers of other livestock, but the surprising thing is that on so many of these farms the bulk of the organic muck comes from other livestock and not from poultry. Thus the presence of poultry muck may be the last straw that causes the problem, but the basic loading of muck on an acreage comes more from other livestock than it does from poultry.

## The cost of removal

We attempted to measure the cost of removing muck from the battery house and from house to disposal point. On average this charge is over £50 per thousand birds per annum, or a shilling per bird per year, with a range from 6*d.* to nearly 2*s.* Similarly, about £70 worth of capital is involved in extra cleaning equipment per thousand birds; perhaps a higher figure than expected. On the whole, problem farms spend less on annual charges and, in particular, less on capital. Perhaps this was why they had a problem. About 40 per cent of the annual cost was on labour; the remaining 60 per cent was heavily loaded with depreciation, interest on capital, etc., on the cleaning gear that was being used. This is shown particularly in areas where units are large and highly-automated, with a capital charge perhaps in the region of £120 per thousand birds for extra cleaning gear. As to be expected, such units have the lowest labour charge (say 20 per cent) but because of depreciation and interest these units still have the highest annual cost. Thus a high capital investment does not necessarily mean lower costs, but it can mean that the unit may survive a shortage of labour or very high labour charges. The probability therefore is that the average poultry farmer is spending a shilling per bird per year merely to move this muck around and lose it.

## The value of poultry manure

A recent N.A.A.S. Technical Report gave a figure of 37*s.* per thousand gallons as the value of undiluted poultry manure. If one assumes that all N.P.K. is available, then this figure could probably be raised to 130*s.* Obviously not all the ingredients are available but, in my own opinion, 37*s.* is far too low and could certainly be doubled. Such figures always cause discussion and a case can be argued either way. There are, however, many farms where cereals are now being grown on poultry manure alone.

The manure output of 5,000 birds for a week is 1,000 gallons and, on the basis of our survey costing of £1 per week per thousand birds, it can be argued that it is costing the farmer £5 to put this thousand gallons in the tanker, take it somewhere, and put it down again. Thus, whatever the N.P.K. value, he is paying £5 a time to move a load. Whether you believe in using muck or whether you believe in just dumping it, if the removal cost is £5 per thousand gallons, it is surely worth putting it somewhere where it can do some good and not be just blown into the wind. A unit of nitrogen may well be cheaper out of the bag, but it is not really cheaper in the overall cost if the farm has muck which has to be disposed of continually.

Another interesting point revealed by our survey was that an average of something like 4,000 gallons of assorted muck was put on each acre of land per annum. Just under half of this came from poultry and just over half of it came from other livestock. This could well be worth 160 units of nitrogen, 160 units of phosphorus and 70 units of potash. Enough surely for any cereal crop and as much as many farmers put on to grassland.

## Handling methods

There are probably two ways which the average man will want to handle muck. First, the use of tanker or pipeline unit in conjunction with a holding pit. Here one feels the really important thing is to have a big enough holding

pit; this should equal at least three months' output and there are many farmers who are arranging to hold material for a longer period than this so that they may use the muck to some purpose for the production of grass or other crops.

The alternative is to have some form of up-to-date muck-heap, possibly roofed, probably with a seepage tank, and with really sensible access for the types of machinery available on the farm. There are indications of a swing away from the hydraulic form of handling towards this midden storage. Such a provision, where the muck is kept as dry as possible, is of considerable interest because it relieves the farmer from worry as to where he is going to put the muck throughout the winter and enables him to use it to some purpose when it is moved. Furthermore, it enables occasional sales to be made from the heap. It is possible that this swing from wet towards drier handling may also be seen in the Americas and in some parts of Europe.

With this line of thinking one would hope to find some changes in the design of muck spreaders which have not changed, apart from detail, for many years. Is there any reason why, for example, a muck spreader could not be 12 feet wide, and designed so that the quantities spread are known and the operator can put on a swathe and see where he has been? There are indications that we may see such changes in the United States.

## The future

Looking at the overall picture, it is clear that some farms, probably only a small proportion, are going to use drying and other advanced techniques to solve their own particular problems. It is equally clear that the great majority of farms will make do with some compromise of conventional methods and that, whichever mode is employed, the muck must go back on to the land. If one tries to measure a true cost for putting it back on the land, then surely one is forced to look at its use as a fertilizer. In a paper to the Institute of Sewage Purification in 1964, Dr. Baines, of the West of Scotland Agricultural College, estimated that the liquid manure produced from cows in Scotland was worth £1,267,000 per annum. The amount of poultry muck which is produced in Great Britain is estimated at 4 million tons per annum; if this is costed at the low figure of 37*s.* per 1,000 gallons mentioned earlier, then we can make a claim for £1·5 million as the annual value of poultry manure. This figure is probably low and could well be doubled.

While it would be absurd to pretend that all the poultry muck produced in Great Britain is in the problem field, these values, albeit theoretical, should make poultry farmers look very hard at the policy of 'throw it away.' The N.A.A.S. poultry advisers have some survey figures relating to muck disposal and, while these figures are by no means complete, a discussion with his county poultry adviser could well help a poultry farmer to arrive at a better knowledge of his own disposal costs. He would probably get a shock!

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This article has been contributed by **C. T. Riley, N.D.P.,** who is a N.A.A.S. Poultry Waste Disposal Specialist. Mr. Riley is stationed in the South-Eastern Region, but his services are available to all other regions.

# Feeding Indoor Sheep

## An Account of Some Trials at Sutton Bonington

G. A. Lodge

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AT a time when productivity is a burning issue, that of the sheep is notably defective. In contrast to the annual production of the dairy cow which may produce its own weight of milk, of the breeding sow which will produce its own weight in pigs, or of the laying hen which may produce six times its own weight in eggs, the breeding ewe manages to produce, with luck, less than half its own weight of lamb and a few pounds of wool. Only the beef cow beats the ewe in the contest for the wooden spoon, as it lacks even the wool.

The glaring defect of the ewe, as primarily a producer of progeny, is its low reproductive rate. Any major improvement in the productivity of sheep must come from improvement in the annual lamb crop per ewe; either with more crops per year, or more lambs per crop, or both. Development in either of these directions will necessitate complementary developments in economical methods for feeding lambs other than on mother's milk and grass. Lambs born in litters would, inevitably, have to be reared artificially, and lambs born in autumn may be reared more economically on direct feeding rather than via the ewe when grazing cannot play a part in the diet.

The fattening of lambs could, therefore, replicate the intensive feeding of beef cattle, with all-concentrate feeding following on from an initial period involving early-weaning. Over the past three winters some trials at Sutton Bonington have looked into various aspects of feeding lambs indoors on single meal or pelleted diets. A brief account of the trials is given in this article.

### The need for roughage

Previous American work had indicated that the ideal dietary combination for lambs after weaning was 55 per cent roughage and 45 per cent concentrates, which contrasted strongly with the prevailing practice of little or no roughage for intensive beef cattle. The first trial, therefore, was designed to investigate whether roughage was, in fact, so necessary for lambs. We did this by giving a diet with a roughage-to-concentrate ratio of 55 : 45, but with

*These are typical of the lambs used in the trials. The slats and empty hay-racks can also be seen*

the roughage fraction either chopped (2 in.), coarsely-ground ($\frac{1}{4}$ in.) or finely-ground ($\frac{1}{8}$ in.) so that it ceased, in the physical sense, to be roughage. The composition of the diets was 55 per cent good-quality meadow hay, 35 per cent maize meal, 10 per cent extracted soya bean meal and a proprietary mineral mix, given in meal form *ad lib.* from self-feed hoppers. The starch equivalent (SE) value of the diet was calculated to be 53 and the crude protein (CP) content 12·5 per cent; sufficient with a weekly intake of 20 lb per head to allow a weekly gain of 1 lb. The sheep were cross-bred store lambs by Suffolk and Oxford rams out of Kerry Hill and Masham ewes, and were 4–6 months old at the start of the experiment. They were housed on slats with no access to feed other than that given in the hoppers.

Introduction to the experimental diets was gradual over a 10-day period during which the lambs changed from grazing to indoor feeding, first on long hay and a limited amount of the maize and soya bean meal mixture and then on to the chopped-hay experimental diet. No difficulty was experienced in inducing the lambs to eat the dry, dusty meal mixtures containing the ground hays and, apart from slight scouring during the initial 3–4 days, there were no digestive troubles. The results over a 10-week experimental period are shown in Table 1.

TABLE 1

| | Average weekly weight gain | Average weekly feed intake | Efficiency of feed conversion |
|---|---|---|---|
| | lb | lb | |
| Chopped-hay diet (2 in.) | 1·3 | 16·7 | 13·0 (11·2 dry matter) |
| Coarse-ground hay diet ($\frac{1}{4}$ in.) | 1·45 | 20·2 | 14·0 (11·9 dry matter) |
| Fine-ground hay diet ($\frac{1}{8}$ in.) | 1·7 | 22·2 | 13·3 (11·4 dry matter) |

A digestibility trial with the chopped and finely-ground hay diets showed that the former was more digestible than the latter: 68 per cent as against 62 per cent. This result was probably influenced to some extent by the ability

of the sheep on chopped hay to select the roughage. The results indicated that although chopped roughage was more highly digested than ground roughage, presumably because it remained longer within the rumen, the higher intake of the ground-hay diets resulted in greater weight gain on the finest-ground material, and efficiencies of feed conversion (EFC) were virtually the same for all.

It did not appear that roughage was necessary for lambs of this type, and the effect of including such a high proportion of material of such low net energy value as hay was simply to reduce net energy intake and limit weekly weight gains to the region of 1·5 lb per week. Thus, although the actual gains obtained exceeded the calculated gain on a diet with only 53 per cent SE, the EFC was so low that it cost 4*s.* 10*d.* in feed to produce a 1 lb gain worth only 3*s.* 2*d.*

## The amount of roughage

The second trial was designed to assess to what degree the roughage fraction could be reduced and the growth rate and EFC improved without making the diets too costly. For this purpose cross-bred store lambs, by Suffolk rams out of Masham and Kerry Hill ewes, were divided into four groups and fed for ten weeks with 0, 10, 20 or 30 per cent ground barley straw included in a basal diet of maize meal and soya bean meal. The compositions of the diets are shown in Table 2.

TABLE 2

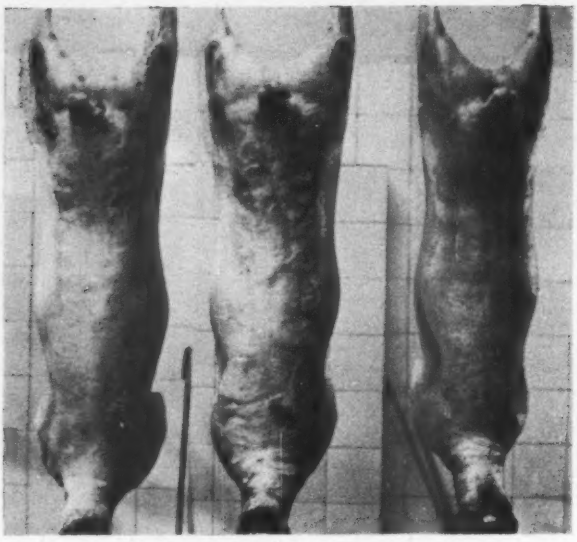
| | A | B | C | D |
|---|---|---|---|---|
| | % | % | % | % |
| Ground barley straw ($\frac{1}{8}$ in.) | 0 | 10 | 20 | 30 |
| Maize meal | 93·75 | 82 | 70 | 58 |
| Soya bean meal | 6·25 | 8 | 10 | 12 |
| Plus 2% of a complete mineral mix added to each | | | | |
| Calculated SE value | 76·5 | 71 | 65 | 61 |
| Calculated CP content | 12·1 | 12·1 | 12·1 | 12·1 |

After mixing, the diets were pelleted to approximately $\frac{1}{2} \times \frac{1}{4}$ in. size and fed *ad lib.* from self-feed hoppers to the four groups of lambs housed on slats. As in the previous trial, introduction to the diets was gradual by giving first long hay and rolled barley, then the 20 per cent straw diet at controlled levels before starting on the experiment proper. Table 3 gives the results of the experiment.

TABLE 3

| Straw level in diet | Average weekly weight gain | Average weekly feed intake | Efficiency of feed conversion |
|---|---|---|---|
| % | lb | lb | |
| 0 | 2·5 | 14·2 | 5·7 |
| 10 | 3·1 | 18·4 | 6·0 |
| 20 | 3·1 | 19·7 | 6·3 |
| 30 | 2·4 | 20·4 | 8·5 |

Although the highest EFC was obtained on the roughage-free diet, surprisingly, perhaps, as this was essentially a pig diet, the fastest weight gains were obtained with the 10 and 20 per cent straw diets because of the



*Carcasses of three of the lambs given the low-roughage diets in pellet form, indicating the degree of fatness of these animals*

higher feed intakes. Best overall performance, therefore, was obtained with 10 per cent straw in the diet but the 20 per cent straw diet gave the best economic return because of the cheapening effect of replacing maize meal with ground barley straw. Feed costs per lb dressed carcass weight for the diets from 0 to 30 per cent straw were 31·3*d*., 30·0*d*., 28·2*d*., and 36·6*d*. respectively.

Although the sheep given the roughage-free diet, which contained only about 2·2 per cent crude fibre, performed surprisingly well, such a diet could not be recommended for sheep because they showed a craving for fibre by grazing on each others' wool. At 4*s*. per lb, wool is an expensive roughage! On slaughter these sheep were found to have wool balls in their rumens, and it may have been the presence of these which enabled them to utilize the concentrate diet with such high efficiency. A digestibility trial revealed digestibilities of dry matter of the 0 to 30 per cent straw diets to be 88·7, 78·9, 75·7 and 69·0 per cent respectively.

It would appear from the second trial that a fibre level of about 10 per cent may be near the optimum. The giving of such a diet, with a SE value of about 70, doubled the EFC and the daily weight gain over those obtained in the first trial with a diet containing 55 per cent roughage. However, a noticeable feature of this second trial was the extreme fatness of the carcasses; as indicated by an average killing-out percentage of 60 on an empty gut basis. Lambs on all treatments were equally fat and it was evident that some modification of the feeding system would be necessary for commercial practice. On the one hand, sheep of a later-maturing type may be necessary, i.e., the sheep equivalent of the British Friesian rather than of the Aberdeen-Angus. On the other hand, a shorter fattening period may be needed to produce carcasses of lighter weight than the 53 lb average of the present trial. Such a modification would, of course, improve the economics of the system.

## Feeding on barley

Both the first and second experiments had maize as a main constituent of the diet, so the third trial was conducted with barley given in various forms: dried or moist-stored and rolled or whole. All diets contained 82·5 per cent

barley, 17·5 per cent soya bean meal plus 2 per cent of a mineral mix; the soya bean meal and mineral mix were given as a combined pellet mixed in with the barley. The diets were calculated to have 4·5 per cent crude fibre, 15 per cent crude protein and an SE value of 68. The barley was either taken straight from the combine at 18 per cent moisture and stored in polythene sacks or dried down to 14 per cent moisture; both forms were rolled a short time before feeding.

Six store lambs by Suffolk rams out of Border Leicester and Kerry Hill ewes were placed on each treatment at about seven months old. As in the previous trials introduction to the experimental diets was gradual. During the experiment, which lasted 5 weeks, the lambs were self-fed and housed on slats. The results of the experiment are given in Table 4.

TABLE 4

| Form of barley | Average weekly weight gain lb | Average weekly feed intake* lb | Efficiency of feed conversion of the dry matter |
|---|---|---|---|
| Moist whole | 3·9 | 23·1 (18·9) | 5·0 |
| Dry whole | 2·6 | 18·2 (16·1) | 6·1 |
| Moist-rolled | 4·9 | 21·7 (17·5) | 3·6 |
| Dry-rolled | 4·0 | 21·7 (18·9) | 4·8 |

*The figures in brackets are dry matter intakes.

Feed intakes were similar, except for that of the dry whole barley which was lower than that of the other three. Efficiencies of feed conversion differed considerably, however, and resulted in the weight gain on moist-rolled barley being double that on dry whole grain.

## Steam-rolled barley

In a final trial steam-rolled barley was compared with dried-rolled barley in the same basic diet as the above. Table 5 gives the results.

TABLE 5

| Form of barley | Average weekly weight gain lb | Average weekly feed intake* lb | Efficiency of feed conversion of the dry matter |
|---|---|---|---|
| Dry-rolled | 3·8 | 18·9 (16·8) | 4·3 |
| Steam-rolled | 4·5 | 22·4 (18·9) | 4·4 |

*The figures in brackets are dry matter intakes.

The steam-rolled barley gave appreciably higher weight gains but this was due entirely to greater feed and dry matter intake and not to improved EFC.

The results of these trials suggest that lambs may be reared rapidly and efficiently on concentrate feeds, that nutritionally there need be no problems, and that the final decision in any case must rest on economic considerations.

Acknowledgments are due to former students A. J. Porter, R. Clark-Monks and M. J. Bryant, who did nearly all the work in the above trials.

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This article has been contributed by **G. A. Lodge, B.Sc., Ph.D.**, who is a lecturer at the University of Nottingham's School of Agriculture, Sutton Bonington, Loughborough. He was formerly at the Rowett Research Institute.

# Trends in Combine Harvester Development

by R. E. Arnold

THE demand for greater capacity, lower losses, easier control, improved driver comfort, and the other challenges to combine designers since the war, point the way to development in the immediate future with one exception. Greater capacity means a faster machine or wider cutter bar, and the largest machines available now are rapidly approaching a point where operator reaction times and the uneven nature of many of our fields must call a halt to this trend. There must, however, continue to be an increase in the capacity of the drum and other systems to keep pace with rising crop yields. This, in the absence of a revolution in design, will clearly have to be met by greater width of the drum, etc., in relation to the cutter bar.

## Possible developments

Better conditions for the operator are the most important immediate aim. The dust problem will not have been satisfactorily solved until much more extensive use of air curtains or well-designed cabs take a lot of the strain out of a long day in the field and reduce the risk of respiratory complaints. It is here and in the other aspects of control that developments can be expected.

It is customary, and in many ways very proper, to attach great importance to losses of grain over straw walkers, sieves and even from the drum, but these usually pall into insignificance compared with those occurring due to crop not getting into the machine in the first place. Better means of loss detection are required so that the operator can devote his attention to driving. Automation of walker loss detection is on the horizon and similar arrangements for sieves and drum must follow. No operator likes having to stop his machine repeatedly in order to carry out an inspection, and few are able to assess accurately the importance of any losses they find.

Similar techniques are required for over-threshing, especially in damp conditions or when dealing with crops that give no visible signs of any damage they are receiving. A cutting height indicator to facilitate returning to the same stubble height after cornering, thereby not congesting the sieves with short lengths of straw, is a likely development. Also, until loss detection is automated, a speedometer to enable the full potential of the machine to be exploited without the risk of overload is another more immediate prospect.

## The threshing mechanism

From the design point of view, the threshing mechanism is the hub of the combine and many developments in design must centre around it. In spite of a vast amount of research to find a less damaging, non-wrapping alternative, there is still no immediate prospect of the rasp bar drum, which has relied on the same principles for 200 years, being superseded. Frictional and centrifugal methods of threshing, which gave promise of replacing the potentially damaging impacts of beater bars, have fallen short in other respects. Consequently, still further development of the existing principle can be expected and low drum speeds remain the only solution to grain damage.

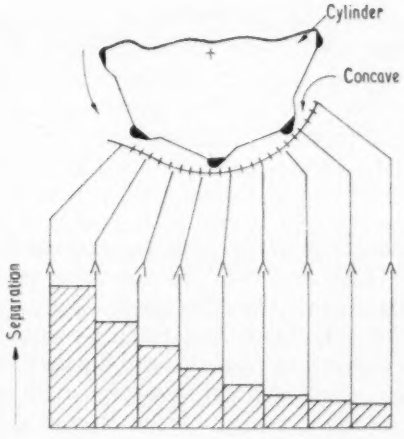


Figure 1.
Separation at the Concave

As straw walker capacity frequently limits combine output, separation in the drum will continue to be a focus of attention. It is the proportion of the cylinder that is surrounded by concave, i.e., the degree of wrap (see Figure 1), and the precise design of concave that decides separating potential. Larger-diameter cylinders, although suitable for use with longer concaves, have been shown to yield only a slight advantage in this respect and none where throughput is concerned. The advantage accruing from increasing wrap is subject to the law of diminishing returns and, even if practicable, excessive coverage is not worth while. However, separating efficiency of 90 per cent or even more can be obtained, given favourable conditions, without incurring prohibitive straw breakage. Those models that incorporate single-cylinder systems and are not attaining this level, can be expected to increase the wrap to reduce the load on walkers.

The American cone thresher (see Figure 2) was aimed at producing the ultimate in threshing/separating mechanism but, although it threshed well and separating percentages in the high nineties were obtained, it did not cope with straw sufficiently well and as it would require a complete revolution in the layout of the machine it is unlikely to be widely used. More conventional are the tandem-cylinder layouts introduced in recent models. No test data are available concerning these as yet, and considerable development can be expected in order to arrive at the best combination of diameters and relative speeds. However, their introduction emphasizes the importance at present being attached to achieving separation in the drum rather than leaving it to the walkers, and may herald the multi-cylinder approach to complete separation.

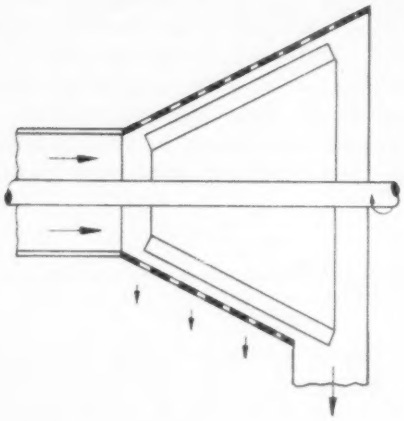

Figure 2.
Conical Cylinder and Concave

## Crop presentation

If the best threshing and separating efficiency is to be obtained from the drum, the crop must be fed (heads first with the ears uppermost) in an even layer at the right speed. It has been shown that up to 50 per cent more grain can go through the concave with heads first feeding compared with butts first (see Figure 3). Lumps in the feed cause violent fluctuations in the power requirement of the drum, which already uses about 80 per cent of the total power requirement of the complete harvester, and they cause equally impressive drops in threshing and separating efficiency. In other parts of the world experiments are in progress in which the forward speed of the combine is automatically adjusted for differences in the density of the crop by sensing mechanisms built into the feed to the drum or cylinder shaft. It is unlikely that our conditions warrant this elaboration, but it might well prove advantageous to add to the list of controls that of crop elevator speed if it proved too expensive to synchronize this automatically with crop density.

The introduction of the pick-up reel was probably the greatest breakthrough in design since combines were introduced but the reciprocating knife, like the drum, remains basically unchanged. Unlike the drum, however, it appears to be nearing its zenith and will soon put the brake on forward speed. This, rather than the ability of the operator, may limit speed for a considerable time. The double knife is unlikely to be acceptable as an alternative.

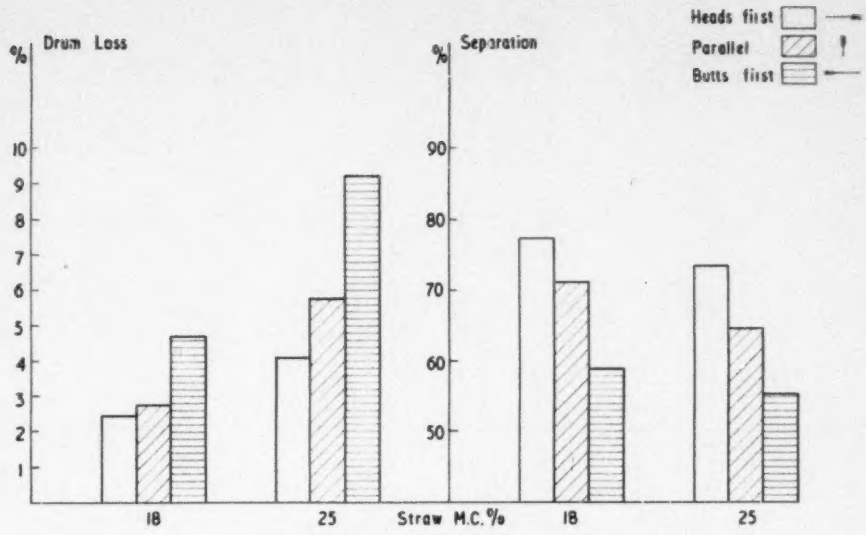


Figure 3. Crop Presentation

## Straw walkers

Contemporary straw walkers have difficulty in keeping pace with drum output in many situations, especially cereals. In the absence of a threshing mechanism that completes the separation, and in spite of rumours concerning rotary devices, straw walkers are, however, certain to feature in the machine for some time yet. Their main virtue, and one not found in other mechanisms, is that, given time, they do an efficient job in all situations. While the search for a better way of doing things continues, they can be expected to develop still further in order to remove the bottleneck that they constitute at the moment and to improve the balance of the machine as a whole.

The inherent inefficiency of the cleaning shoe in a combine is usually only apparent in small seed crops like grasses and clovers. The action of moving air and sieves should not be confused as it is at present. The light impurities in the sample should be blown clear, preferably in a vertical aspirating column, before the sieves get to work. Given accurate air control, losses of small seeds could then be greatly reduced. Sieve output would be increased and the risk of blockages greatly reduced under all conditions. This might also exclude the need for much barn cleaning machinery, and the labour costs that go with it. It might also initiate a trend to greater complexity of the combine which, if the potential area covered in a day is reaching the limit, must be followed in order to get better returns from labour.

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The author of this article is **R. E. Arnold, B.A.**, of the Harvesting and Handling Department of the National Institute of Agricultural Engineering, Wrest Park, Silsoe, Bedford.

# Machinery Syndicates

## — A Progress Report

**by Charles Wood**

THERE has been considerable progress recently in the sphere of machinery co-operation; the fact that about 1,000 syndicates of all kinds have now been formed in this country bears witness to this. Progress is also represented by the extent to which what some might think to be one of the trickiest situations imaginable, i.e., more than one person having access to a single machine, has been resolved by syndicate ownership.

Farmers must have borrowed each others' equipment ever since someone made the first spade and, depending upon the temperament of the sharing partner, the inevitable friction must have arisen! Today, when elaborate and expensive equipment is involved and when timeliness of operation is so important, sentiment and bias against sharing have to give way to economic pressures of the times.

Among the first questions asked by farmers considering syndication are those which arise from their own inherited attitude of independence. In the past this attitude has led to uneconomic investment in machinery and equipment which too often was not fully utilized. Farmers also express concern about possible arguments arising from breakdowns and as to who is to use a particular machine during good weather; as well as other unfounded fears. Nevertheless, it is quite remarkable how, once a group of individuals in a district have got the possibilities of syndicate ownership firmly in mind, the potential for co-operation grows; where there's a will, there's a way. Not only are the same machines operated on several farms, but there is usually a free exchange of workers so that maximum use can be made of the equipment. Records are kept of hours worked on the various holdings and a grand settling-up is made at the end of the year. Farmers who adopt the syndicate principle of ownership are noticeably less cluttered up with machinery than those endeavouring to be self-contained. With present-day high capital costs, it is to everyone's advantage if machinery is used to full capacity.

### The business structure

The business structure of machinery syndicates has been worked out by the various bodies concerned, i.e., the Agricultural Central Co-operative Association, the N.F.U.-sponsored county syndicate credit companies through which special credit terms can be obtained, and the banks. In 1962

*The forage harvester has proved to be one of the most suitable machines for syndicate ownership*

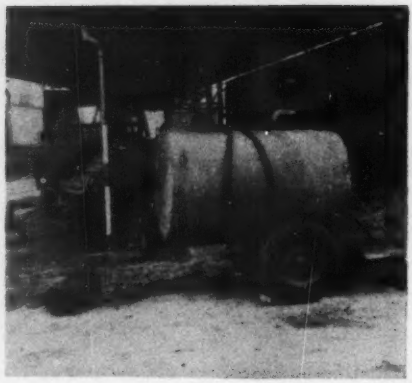
the companies decided to form a Federation to take over the functions of co-ordinating established companies, promoting new companies and reviewing current experience to ensure that farmers' requirements are met. The Federation also provides publicity and advice at national level, and represents common interests of the movement in negotiations with government departments, trade organizations and others.

The soundness of proposals for the formation of syndicates is efficiently judged by the board of the appropriate syndicate credit company, which is made up mainly of experienced syndicate members. A suggestion is usually made that the syndicate secretary should not be a participating member, but should be someone with actual secretarial and accounting experience. A generous annual payment or honorarium represents money well spent! Codes of local rules are drawn up at the inception of individual syndicates, and it is interesting to note that the original rules devised for the first syndicate set up in Hampshire have proved so successful that they remain virtually unchanged.

An early fear was that the farmer with a small acreage might be at a disadvantage in a syndicate which contained farmers with greater acreages. In practice such combinations have been found to present no special difficulties: loan payment and usage rights are based on acreage involved or, in the case of syndicates involving feed preparation facilities, they are based on tonnage processed.

A worthwhile recommendation is that when repair of syndicate-owned machinery is needed it should be undertaken by an approved local specialist engineer. This has the effect of relieving individual members of responsibility, and of reducing calls on specialized farm labour. It almost always results in equipment being maintained in better condition generally.

Rather surprisingly, the larger farmer has been more interested in syndication than his neighbour with fewer acres. This is not quite what one would expect, and the probable explanation is that the small farmer is usually more vitally interested in livestock as a first consideration, whereas the large farmer is often progressively seeking to expand his business generally. However, by coming into a syndicate the farmer with few acres



*The large cultivator for stubble clearing shown on the left and the slurry tank (right) are examples of the type of machinery which can be shared by farmers in syndicate*

is soon able to realize from example that his best chance of expansion may be greater intensity through the use of efficient high-capacity machinery, such as his neighbour uses on a larger scale.

## The machines

In Hampshire, where there are now well over a hundred syndicates, the pattern has mainly been limited to machines such as forage harvesters, pick-up balers, combine harvesters, hedge-cutters, ditching machines and manure spreaders. These are, of course, mainly concerned with seasonal operations and can readily be shared; but as the farming pattern changes the scope of machines suitable for co-operative ownership can be expected to widen to include other types not so far encountered to any extent in syndicates.

Since there is no restriction in cost, there is growing appreciation of the advantages of equipment which has a high capacity and high quality. Examples are crop sprayers, slurry disposal tankers and super-combines. Use of high-capacity combines is leading to an increasing interest in the sharing of grain drying and storage plants. These take one of two distinct patterns; either there may be the small syndicate of two or three farmers who share a continuous flow drier and store the grain on their respective farms, or the project may involve a large ventilated-silo drying and storage installation. In the latter situation each syndicate member virtually has his own drier incorporated in such a plant. Since progressive farmers now almost universally handle grain and feed in bulk, the syndicate ownership of weigh-bridges is a development which will become more and more common.

## The future

Looking into the future, progress in machinery syndication is likely to be steady and continuous as more and more farmers realize the necessity for conserving capital. The farmer who is faced with the choice of buying a forage harvester or two more cows may, by joining a syndicate, be able to have both the machine and the two cows. This must be good business!

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**Charles Wood, A.M.I.Agr.E.,** is the N.A.A.S. County Mechanization Adviser for Hampshire and the Isle of Wight, a post he has occupied since 1950.

E. R. Bullen

# Break Crops on Heavy Land

TRADITIONAL heavy-land rotations were built around a few break crops such as beans, clover and bare fallow. More recently a tendency has developed, particularly in the forties, to add potatoes or sugar beet.

Break crops are held to be an essential part of arable farming for a variety of reasons. Some of these reasons no longer apply quite so forcibly owing to technical and economic changes. For example, it is usually cheaper to supply nitrogen in fertilizers than to grow a leguminous restorative crop, and it may be easier to control weeds by treating a grain crop with an appropriate herbicide than to hoe between the rows of the legume.

Some of the advantages once claimed for a fixed rotation now almost look like disadvantages. For instance, the idea of spreading the work load by a series of crops may easily give numerous enterprises, all of which cannot be adequately mechanized while at the same time maintaining a reasonable level of fixed costs.

Nevertheless, the soil-borne diseases of cereals can only be controlled by a break crop. These diseases will probably increase in importance since there is no question that cereals are likely to dominate clayland arable rotations in the next few years. But which cereals? Oats are unfashionable now, and the acreage tends to drop steadily. This unpopularity is not entirely attributable to low yields, although oat yields are more erratic than barley. The

oat crop has more critical requirements for sowing date, and other cereals are more suited to modern methods of harvesting and storage.

## Continuous barley

The barley crop continues to expand, and on many heavy-land farms yields seem to be maintained at a worthwhile level under continuous barley provided grass weeds—wild oats and couch—have been kept in check. It might be wondered whether there was any place for the break crop under this sort of husbandry. Technical progress with better varieties and weed control should ensure that yields can at least be maintained. For example, in one trial at Boxworth, a ninth consecutive barley crop in 1965 yielded 53 cwt per acre at 100 units nitrogen. I find it hard to visualize any other preparatory crop than eight barleys giving a much higher yield! This is clearly something of a freak result and on occasion circumstances—notably couch or take-all—may necessitate a break, even for the barley baron.

Is a rotation which is, in fact, a sequence of barleys the best bet for the heavy soils of eastern England? Economic data suggests that the gross margin for wheat commonly exceeds that for barley by £7 to £10 per acre. If the national barley acreage continues to expand—and more and more farmers in other areas are climbing on the barley band-wagon—it seems possible that this difference will not diminish.

## Continuous wheat

Can one grow continuous wheat? The technical problems are serious even if climate and soil are favourable. Minimizing the effects of take-all, eyespot, blackgrass and wild oats, will keep the farmer—and his adviser—on the alert technically.

Assuming that continuous wheat is within the technical capacity of a farmer, and that his farm is suitable, is this a better bet than continuous barley or is it more economic to grow winter wheat in a rotation with break

*Cappelle wheat—Sykes Field, 1965*

crops? The answer depends on three factors—yield levels, variable costs and fixed costs. Each of these is not necessarily the same for continuous and rotation wheat. The following figures from Boxworth, based on 1964 and 1965 plot yields, indicate one situation as far as yield and variable costs are concerned.

TABLE 1

| | Wheat after beans | Second wheat crop | Sykes Field (continuous wheat) |
|---|---|---|---|
| Yield (cwt/acre) | 44½ | 43 | 38 |
| | £ *s.* | £ *s.* | £ *s.* |
| Gross return (per acre) | 57 17 | 55 18 | 49 4 |
| Variable costs (per acre) | | | |
| Seed | 2 11 | 2 11 | 2 11 |
| Fertilizers | 2 17 | 3 15 | 5 2 |
| Sprays | 18 | 18 | 2 8 |
| | 6 6 | 7 4 | 10 1 |
| Gross margin (per acre) | 51 11 | 48 14 | 39 3 |

Yields are means for plots in 1964 and 1965 of Cappelle wheat.

Gross return is based on wheat at 26*s.* per cwt (mean guaranteed price 1964 and 1965).

Seed is assumed to be 1¼ cwt at 34*s.* per cwt.

Fertilizer: 1 cwt triple superphosphate at 21*s.* per cwt.
Sulphate of ammonia at 12*s.* per cwt (60 units after beans: 90 units second wheat: 135 units Sykes).

Sprays: CMPP on all plots (6 pints at 24*s.* per gallon).
Wild oat herbicidal spray every other year on continuous wheat at £3 per time, charged at 30*s.* to each crop.

It is difficult to be certain whether this situation is typical. Clearly, as plot yields exceed field yields, returns will be abnormally high, but the comparison between columns should be valid. However, our field experience suggests that the yield difference may well be more—say 10 cwt—between wheat after break and continuous wheat. I should be surprised to achieve a gross margin over £35 on continuous wheat on a large scale.

Our evidence on continuous barley is complicated by experimental work on wild oats, and would not be a reliable guide to the potential of the system. On the basis of a £7 16*s.* variable cost*, one would have to average about 39 cwt barley to beat Sykes Field. This seems improbable, and the experience of farmers growing long barley sequences suggests that one should not expect to average more than, say, 32 to 34 cwt per acre over a period of years. At this yield level, the gross margin is approximately £30 to £32 per acre. This is below the £35 that might be expected for continuous winter wheat, but is much safer technically.

In a three-year sequence the above figures suggest that two wheat crops after a break, even if some deduction is made for plot yields, have given a total return not much below three continuous barleys. The rotation wheats

*Seed cost assumed to be 1¼ cwt at 34*s.* per cwt.
Fertilizer 3 cwt compound plus 40 units sulphate of ammonia.
Herbicide MCPA each year and wild oat herbicide every third year.

*Beans in trial to study effect of a break crop after 15 cereals*

will therefore pay better than continuous barley so long as the break crop does not increase fixed costs and leaves sufficient return to cover its variable costs.

## Break crops

When comparing rotation wheat with Sykes Field, a third year devoted to any break crop which does not increase fixed costs is justified provided it leaves a gross margin of about £17 to bring the total gross margin for the three years up to £117 (3 × £39).

Except on farms where the grain equipment is already at full stretch, fixed costs are not likely to be increased either by those break crops handled by grain equipment, e.g., beans, oil rapes, mustard, or by hay with or without clover seed, since haymaking equipment is normally available on the arable farm. Some details of probable returns in West Cambridgeshire are given in Table 2. I am indebted to the Farm Economics Branch, University of Cambridge, for permission to quote them.

TABLE 2

**Mean yields and outputs West Cambridgeshire 1961-1964**

| | Average yield (cwt/acre) | Gross output | Variable cost (assumed) (per acre) | Gross margin |
|---|---|---|---|---|
| | | £ *s.* | £ | £ |
| Beans | 21½ | 30 1 | 5 | 25 |
| Hay | 31 | 12 7 | 6 | 7 |
| Hay + Seed | 28 (hay)<br>2·8 (seed) | 13 0<br>24 0 | 6 | 31 |

On this basis, either beans or hay + seed give a return which is economic by comparison with continuous wheat.

Are there other break crops better than beans? Local experience with oil rape is insufficient to give any clear advice, but the evidence, such as it is, suggests that the returns in recent years would not have exceeded the figure quoted for beans and that the variable costs, largely because of heavier nitrogen requirement, would have been at least £7. Mustard is grown by a few farmers; the figures suggest the return is, on average, about £4 per acre less than beans, again with higher variable costs because of extra nitrogen and insecticide. Herbage seed crops, though quite attractive on paper, give erratic returns. Timothy harvest clashes with the cereal harvest. The ryegrasses, fescues and cocksfoot would not conflict so severely with the grain harvest, but blackgrass, which is a major problem on many heavy-land farms, is a scheduled weed so far as they are concerned.

If the problem is viewed through gross margin spectacles, the solution lies with potatoes or sugar beet where one could well expect gross margins of £75 to £100 per acre. However, the gross margin approach over-simplifies the problem. In particular, the labour requirements of root crops on heavy land tend to be high. Although mechanization could, theoretically, reduce labour requirements, the possibility of the wet autumn must never be overlooked. The last three Octobers have all been dry. Even so mechanical beet and potato harvesting has been far from perfect on heavy land and, in the present state of mechanical development, the farmer has not merely to carry the machinery charges but has to have some labour available as well. This loads the dice against root growing on heavy land when compared with lighter land where machinery works more effectively. In some circumstances the problem may be eased by casual labour. All too often, however, the good gross margin of cash roots is achieved at the expense of high fixed costs and a low return on the capital invested in root-growing equipment. The latter can seldom be fully utilized on the average clayland farm.

## The ley

The ley is another possibility. The problem here is primarily economic, i.e., how to utilize the ley to achieve a worthwhile income over fixed costs, although there are technical problems of seeds mixtures and establishment on clay soils in dry areas.

Judged on the basis of subsequent crop yield in our ley fertility trial, the best of the 3-year leys is lucerne, followed by a grazed ley. A mown grass ley appears to be less beneficial under the circumstances of this particular trial than a one-year clover ley. If one grows lucerne, it has to be conserved and, as Table 1 shows, hay is hardly an attractive cash crop. Grazing leys by sheep, by dairy heifers or by store beef cattle traditionally do not give much income, and commonly the return from these enterprises has only just sufficed to cover fixed costs. There are grounds for thinking that by integrating (1) recently-developed ideas for more intensive manuring, (2) high rates of stocking of fairly young animals, and (3) the use of conserved material in drought periods to enable maximum stock to graze minimum grass, gross margins of over £30 per acre can be achieved. To do this, the alternatives are either grazing '18-month beef' in their summer at grass or rearing dairy heifers—provided they calve at two years. However, it should be borne in mind that the return on capital with any livestock enterprise cannot compare with cash cropping.

Lastly, there is the possibility of the bare fallow. It is hardly attractive in these days of highly valued land, but is still justified in the special circumstances of a serious couch problem provided the wheat bulb fly can be persuaded to leave the subsequent wheat crop alone.

## Summing up

Clayland farms vary so much that one cannot sum up the possibilities by offering a 'best buy' for break crops; there are, in fact, some which have not been mentioned for reasons of space. The guiding principle in planning a heavy-land rotation should be to minimize unit costs, because on a clay farm certain items like drainage are bound to be more expensive than on kinder soils.

Lower unit costs can be achieved in three ways. Firstly, fixed costs must be kept down, which usually implies a system built round the combine. Secondly, variable costs must be watched, especially the technically attractive but costly grass weed herbicides. Finally, returns must be kept up, which implies a high, but not unreasonably high, proportion of wheat and also means aiming at the maximum economic yield of all crops. Yields are especially important, partly because higher yields do not mean a commensurate increase in costs—thus reducing unit costs, and partly because the better the crop the less chance grass weeds have to compete.

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# The Ministry's Publications

Since the list published in the February, 1966, issue of *Agriculture* (p. 86) the following publications have been issued.

MAJOR PUBLICATIONS

Bulletin No. 154. Grass and Grassland (Revised) 8*s.* (by post 8*s.* 7*d.*)
Experimental Horticulture No. 14. February 1966 (New) 6*s.* 6*d.* (by post 7*s.*)

ADVISORY LEAFLETS

(*Price* 4*d. each—by post* 7*d.*)

No. 270. Soil Analysis for Advisory Purposes (Revised)
No. 413. Verticillium Wilt of Hops (Revised)
No. 451. Wasps (Revised)

FREE ISSUES

Can You Recognize Tulip Eelworm (Revised)

*The priced publications listed above are obtainable from Government Bookshops (addresses on p. 146), or through any bookseller. Unpriced items are obtainable only from the Ministry (Publications), Tolcarne Drive, Pinner, Middlesex.*

# Milk Testing

## — and Sterilizing Agents

C. A. Scarlett

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DAIRIES are now testing milk from farms on a wide scale, and one of the tests is for the presence of antibiotic residues. For this purpose a modified form of the TTC test (involving incubation at 37°C) has been developed to detect the presence of penicillin in milk. In this test amounts of penicillin less than 0·05 i.u./ml. (international units per millilitre) give a negative result (i.e., the sample passes the test), and amounts greater than 0·05 i.u./ml. give a positive result (i.e., the sample fails the test).

Compounds other than penicillin are also used in the treatment of various forms of mastitis; these compounds may inhibit the growth of the organism—*Streptococcus thermophilus* B.C.—which is used in the test, and thus give a result similar to that produced by penicillin. It has also been suggested that approved chemical agents such as hypochlorites, iodophors and detergent-sterilizers based on either quaternary ammonium compounds or chlorine compounds, if present in milk, might give a test result similar to that of penicillin.

It should be emphasized at once that traces of approved chemical agents should not be present in milk and would not be if utensils were properly rinsed and allowed to drain, as required by the Milk and Dairies (General) Regulations 1959, before again coming into contact with milk. Their presence would not only be a contravention of the Regulations but could also result in the milk being rejected by the buyer on account of taint.

However, to ascertain the effect of these chemical agents and also hibitane which is used as an udder wash and teat dip, when present in milk, a series of experiments has been carried out by the Ministry using both the full and the modified TTC test procedures. It has thus been possible to estimate, in terms of penicillin, the effect produced by these materials and to determine the amounts of them that would be necessary to bring about a 'fail' reaction using the modified TTC test. Some typical results obtained are set out in Table 1.

These results demonstrate clearly that large amounts of approved chemical agents, e.g., hypochlorites, chlorine compounds, iodophors and quaternary ammonium compounds, must be present in milk to lead to a failure in the modified TTC test.

TABLE 1

| | Strength (parts per million) | Equivalent to penicillin i.u./ml. Full TTC test | Modified TTC test result |
|---|---|---|---|
| *Chemical agent* | | | |
| Chlorine (Hypochlorites and chlorine containing compounds) | 1,500 | 0·04 | Pass |
| | 1,750 | 0·05 | Pass |
| | 2,000 | 0·06 | Fail |
| Iodine (Iodophors) | 170 | 0·045 | Pass |
| | 180 | 0·05 | Fail |
| Benzalkonium Chloride (Quaternary ammonium compounds) | 120 | 0·05 | Pass |
| | 130 | 0·06 | Pass |
| | 140 | 0·075 | Fail |
| *Udder wash* | | | |
| Hibitane (Chlorhexidine digluconate) | 50 | 0·03 | Pass |
| | 60 | 0·05 | Pass |
| | 70 | 0·10 | Fail |

Table 2 sets out the amounts of these materials required to give a failure in the modified TTC test, the approximate amounts of these materials likely to be present in the detergent-sterilizer wash when made up ready for use for cleansing dairy equipment, and the probable amounts in a 10-gallon churn of milk assuming that $\frac{1}{4}$ pint of wash solution had been carelessly left in the churn.

TABLE 2

| Active chemical agent | Parts per million to cause failure in TTC test | Parts per million in wash solution | Approximate amount (in parts per million) present if $\frac{1}{4}$ pint of wash water left in 10-gallon churn of milk |
|---|---|---|---|
| Chlorine (Hypochlorite) | 2,000 | 250–300 | 0·8 |
| Chlorine (Chlorine containing compounds) | 2,000 | 200–250 | 0·7 |
| Quaternary ammonium compounds | 140 | 180–200 | 0·6 |
| Iodine (Iodophors) | 180 | 70–80 | 0·25 |
| Hibitane—as udder wash | 70 | 200 | 0·6 |
| —as teat dip | 70 | 5,000 | 16·0 |

It will be seen that the results of these experiments lend no support to the suggestion that traces of approved chemical agents or hibitane present in milk as the result of normal dairy use can cause the milk to give a fail reaction to the modified TTC test even when no antibiotic is present. Producers thus need have no fear that they may be unjustly penalized by the proper use of approved chemical agents or hibitane.

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This article has been contributed by **C. A. Scarlett, B.Sc., A.K.C., F.R.I.C.,** who is the N.A.A.S. regional bacteriologist in the South-Eastern Region.

# Maincrop Potatoes

## Planting Methods and Labour Requirements

J. H. Clift

No one doubts the heavy labour demands of potato production. However, there is considerable scope for reducing labour requirements in the production, harvesting and handling of maincrop potatoes. Some methods for a particular job in the production cycle require perhaps seven or ten times the amount of labour required by other methods for the same job.

Farmers are continuously improving their methods of work, as new designs of machinery become available. The total worker hours requirement for conventional hand-picking methods of harvesting maincrop potatoes ranges from 30 to 60 (or more) per acre, depending on variety, yield, quality and rate of payment of labour, type of lifting and handling machinery, and actual method of working. Complete mechanical harvesting has on many farms reduced this total labour requirement to a range of 18 to 35 worker hours per acre, depending to a large extent upon the degree to which mechanical separation of potatoes from clods and/or stones can be achieved.

Under extremely favourable soil conditions, it has proved possible to operate a complete harvesting system that requires no manual pickers to travel on the harvester. If, in addition, soil separation on the harvester mechanism can be finely gauged, the output from such an unmanned harvester can be loaded into an elevating-cum-tipping trailer, which in turn eliminates the usual potato store elevator and its attendant worker. The manpower of such a harvesting system then comprises one driver for the tractor pulling the harvester and two or three tractor-trailer drivers. Under such excellent soil conditions, it may be possible to lift two-thirds of an acre per hour; this has proved practicable and indeed has been exceeded by conventional two-row elevator diggers under favourable soil conditions. The total labour requirement for harvesting is then 6 worker hours per acre.

There are other examples of substantial reductions in labour. The labour content of keeping weeds under control after planting can be as low as 0·2 worker hours per acre where herbicides are used, but it can be, on average, 2·6 worker hours per acre if a combination of the traditional cultivations of harrowing the ridges down, cultivating the row bottom and re-ridging is employed.

Again, at the time of unloading the store, perhaps 20 worker hours per 10 tons gross yield will be required if the usual system of farm grading is in

*This 1-ton box of potatoes was transported by tractor from store to a trailer parked on a headland. A home-made chute inserted in the pallet base of the box enabled the potatoes to flow down into the planter*

operation. If this operation is eliminated and the store is unloaded in bulk for the produce to be graded at a central grading station, a figure of 2·0 worker hours per 10 tons gross yield is more applicable. Where once-grown seed is to be retained on the farm and the ware is to be handled and transported in bulk boxes to a packing station, a half-way stage, around 11 or 12 worker hours per 10 tons gross yield, can be achieved if the farm store stock is given a primary grading into seed, ware and outgrades.

## Planting

Many maincrop producers plant chitted seed by means of a hand-fed 3-row planter. This system generally requires, in the field alone, a minimum gang of five workers. These are the tractor driver, three workers feeding the planter mechanism and a fifth worker who rides on the planter in order to move the trays to keep the planter workers busy down the whole length of the row. On a two-row chitted seed planter, the empty trays can be moved aside by both planter feeders, but the middle feeder on a three-row machine is unable to move his empties.

The 3-row planter method requires, on average, 7·5 worker hours per acre, and has a system output of 0·6 acres per working hour. In addition, it is generally necessary to apply the fertilizer separately, during or after the ridging-up operation. The combined weight of planter, seed and workers is usually considered to be as much as can be suitably carried, especially if ground conditions are at all difficult. The separate task of fertilizer application is not, in itself, a job which uses many man-hours, but it involves a separate pass over the land by man and machine and thus adds an extra tractor and man to the minimum gang required for the overall task. There is now a total requirement of two tractors and six workers, quite apart from handling and haulage of seed and fertilizer materials from the buildings to the field.

This commonly-operated 3-row chitted seed method can be compared with planting unchitted seed by an automatic 2-row planter which simultaneously applies the fertilizer. Here the minimum gang is only one man, i.e., the driver, and the system output is 1 acre per working hour, on average. In an area of severe shortage of casual and regular labour, a farmer may have to decide whether it is prudent to forego the advantages of chitting, in respect of earliness of maturity, yield and avoidance of disease, in order to take advantage of a system which uses only one-seventh of the labour, and in terms of time is approaching twice as fast as the chitted seed method.

## Bulk handling of seed

Another prospective improvement to the automatic method of planting of unchitted seed is the elimination of manual handling of individual sacks of seed, and its replacement by mechanical handling of bulk containers of seed. Instead of loading sacks on to trailers at the farm by hand, only to unload them in the field and tip them into the planter, can seed be conveyed in bulk and poured into the planter hoppers?

One system designed and built by a pioneering farmer in 1965 was to handle seed in strongly-constructed one-ton-capacity boxes. When bulk-stored potatoes were being graded and seed was being saved, these boxes were filled direct from the grader, and in due course hauled to the headland of the planting field and located on a parked trailer. They had a gate in one side to enable the potatoes to fall into the planter hoppers.

The unchitted automatic method may, in fact, be three times as fast, and require only one-ninth of the worker hours, as one chitted seed method which is practised on heavy soils where the planter, of 2-row capacity, opens the ridges, places fertilizer, plants and covers over. Yet such a labour-demanding method may be used by a farmer who is very labour conscious if he has a heavy soil which is easily compacted. Personal experience may indicate that planting in wheelings can lead to a serious reduction in yields.

This is one example of the necessity for agricultural work study information to be linked very closely to husbandry objectives. But there would be no point in carrying out agricultural work study unless one constantly asks the questions 'why' and 'how'. If, as a result of asking 'why', one remains convinced that chitting is an essential technique, one can still ask how else can chitting and planting chitted seed be carried out?

## Tray handling

At this point the question arises whether it is necessary to handle each chitting tray individually, stacking and unstacking in the chitting house, re-loading individually on to trailers, off-loading individually on to the planter, and again re-handling each tray in turn during and after the planting operation. Can the stack of trays be palletized at the time it is set up in the chitting shed to permit mechanical handling later? Is there a future for maincrop producers in the continental practice of sprouting the seed out of doors under a polythene cover with a suitable heat source to avoid chilling? It is an example of a different approach to the traditional task, offering (1)

*Instead of transferring all the trays from the transport vehicle to the planter, this chitted seed planter has a hopper into which trays of seed are carefully poured*

the prospect of reduced capital outlay, and (2) easier handling if the trays are on pallets. Compare this situation with some chitting houses with their inconvenient access for transport, or their need to stack to great heights if the house is to hold enough trays, thus increasing the size of gang needed to stack up and lift down the trays each time they are handled.

When planting chitted seed, must every single sett be individually picked out from the chitting tray in order that it may be placed in the planter mechanism? By and large, according to my observations, maincrop growers using chitted seed hump all the trays off the trailer on to the planter and the planter workers pick out each sett in turn. But sprouts still seem to get knocked off in the process, as can be seen on the deck of the planter when it returns to the trailer for re-filling.

One way of eliminating the need for a fourth non-productive worker on a 3-row planter is to avoid putting the trays on to the planter at all. I have seen chitted seed planters fitted with a hopper, into which the trays are gently poured at the side of the trailer. This operation is almost certain to knock off some sprouts, but only carefully-conducted experiments would show if it damages more than when planter workers are grasping setts directly out of trays.

Another approach is to continue to load trays on to the planter, and have a fourth worker on a 3-row planter. But instead of each planter worker reaching into a tray, the potatoes in the trays are gently poured out into a position as close as possible to the planter feeding mechanism. The planter feeder has the shortest distance to reach for each sett. The same principles of motion economy, of keeping the components within easy reach of the working-point, are applied in mass production factories making television sets. By using this method, the planter feeders can concentrate all their energies on planter feeding, and empty chitting trays are never in their way. Also the trays can be neatly nested and re-stacked ready for quick off-loading at the trailer. This saves time at the headland trailer when reloading and reduces the wear and tear on the trays which, at a cost of 5*s*. per tray, deserve careful handling.

With this method, on one farm last season the planter was in work, actually planting in the rows, for 80 per cent of the working time, and the women were each handling 100 setts a minute. On other farms that did not use this method, the percentage time actually planting in the rows was lower, in one case as low as 50 per cent, and the number of setts handled per minute per worker was also reduced, down to 75 or less. It is, however, imperative that the safety of the worker who is handling the trays must receive proper consideration, and that adequate precautions be taken to this end.

## Future prospects

Finally, what is the prospect for planting chitted seed automatically? There appears to be a dearth of experimental evidence. There would, however, seem to be a prospect that if the sprout is small and sturdy, automatic planting is technically feasible. It may well be that careful reconsideration of planter design problems will be necessary before automatic planting of chitted seed becomes widely applicable.

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This article has been contributed by **J. H. Clift, B.Sc. (Agric.)**, who is the N.A.A.S. Farm Management (Work Study) Adviser in the Yorks/Lancs Region.

# AGRICULTURAL CHEMICALS APPROVAL SCHEME

Since the publication of the 1966 List, the following products have been approved:

## INSECTICIDES

**TETRADIFON with MALATHION**
For the control of red spider on glasshouse crops.
*Smoke Formulations*
**Tedion V-18 Smoke Generators Extra—Mi-Dox Ltd.**

## FUNGICIDES

**CAPTAN**
*Wettable Powders*
**Boots Captan Dispersible Powder—Boots Pure Drug Co. Ltd.**
**Bulpron—Baywood Chemicals Ltd.**

**DICHLOFLUANID**
For the control of botrytis on strawberries.
*Wettable Powders*
**Elvaron—Baywood Chemicals Ltd.**

**MANCOZEB**
*Wettable Powders*
**Dithane 945—J. W. Chafer and Co. Ltd.**

## HERBICIDES

**AMETRYNE**
A foliar and soil acting weed-killer for the control of annual weeds in potatoes.
*Wettable Powders*
**Gesapax—Fisons Pest Control Ltd.**

**BENAZOLIN (4-chloro-2-oxobenzothiazolin-3-ylacetic acid) with 2, 4-DB and MCPA**
A translocated weed-killer for the control of many broad-leaved annual and perennial weeds including chickweed and cleavers in undersown cereals. For post-emergence use in cereals (including undersown) and direct-sown grass/clover mixtures in the year of drilling.
*Potassium and Sodium Salt Formulations*
**Legumex Extra—Fisons Pest Control Ltd.**
**Ley Cornox—Boots Pure Drug Co. Ltd.**

**6-cyclohexyl-2, 3, 4, 5, 6, 7—hexahydro-5, 7—dioxo-4, 6-diazaindene**
A soil acting weed-killer for the control of annual weeds in sugar beet.
*Wettable Powders*
**Du Pont VENZAR lenacil weed-killer—Baywood Chemicals Ltd.**
**Du Pont VENZAR lenacil weed-killer—Fisons Pest Control Ltd.**
**Du Pont VENZAR lenacil weed-killer—Pan Britannica Industries Ltd.**

**2, 4-D**
*Amine Salt Formulations*
**Dioweed 50—J. D. Campbell and Sons Ltd.**
**Farm Chemicals 2, 4-D (50 A)—Farm Chemicals Ltd.**

**DALAPON**
*Sodium Salt Formulations*
**Farm Chemicals Dalapon—Farm Chemicals Ltd.**

**2, 4-DB**
*Potassium and Sodium Salt Formulations*
**Farm Chemicals 2, 4-DB—Farm Chemicals Ltd.**

**2, 4-DB with MCPA**
*Potassium and Sodium Salt Formulations*
**Farm Chemicals 2, 4-DB Extra—Farm Chemicals Ltd.**
**Lomnitox—Baywood Chemicals Ltd.**

**DICHLORPROP**
*Potassium Salt Formulations*
**Farm Chemicals 2, 4-DP—Farm Chemicals Ltd.**
**Murphy 2, 4-DP—Murphy Chemical Co. Ltd.**

**DICHLORPROP with MCPA**
*Potassium and Sodium Salt Formulations*
**Farm Chemicals MCPA + 2, 4-DP—Farm Chemicals Ltd.**
**Stantox Plus—S.D.C. Pesticides Ltd.**

**DIMEXAN with chlorbufam (BiPC) and cycluron (OMU)**
For pre-emergence weed control in sugar beet. Has contact action on emerged weeds with some residual action.
*Liquid Formulations*
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**IOXYNIL with MECOPROP**
*Potassium Salt Formulations*
**'Actril' C—May and Baker Ltd.**

**MCPA**
*Potassium and Sodium Salt Formulations*
**Arnox MCPA—Holmes, Mullin and Dunn Ltd., Lobitos House, Knock, Belfast 4 (Belfast 656311)**

**MCPB with MCPA**
*Potassium and Sodium Salt Formulations*
**Farm Chemicals MCPB plus MCPA—Farm Chemicals Ltd.**

### Omission in the 1966 List

**PHORATE**
*Granular Formulations*
**Thimet Phorate 10% Granules—Cyanamid of Great Britain Ltd.**
The entry in the 1966 List of Approved Products should be amended by the addition of *potatoes* to list of crops treated. The pests controlled should also include cabbage root fly (brassicas) and capsids and leafhoppers (potatoes). When phorate is applied to potatoes for aphid control, some reduction of wireworm damage is also achieved.

### Additions to 'Chemicals for the Gardener'

**BOOTS ROSE FUNGICIDE**
**Based on captan and dinocap—Boots Pure Drug Co. Ltd.**

**BOOTS SYSTEMIC GREENFLY KILLER FOR ROSES**
**Based on dimethoate—Boots Pure Drug Co. Ltd.**

### Change of Address

**Shellstar Ltd. Previously of Shell Centre, London, S.E.1, are now at 70 Brompton Road, London, S.W.3 (Tel. Knightsbridge 7060).**

# 38. Fishguard, Pembrokeshire

**David Arnott**

THE Fishguard district of Pembrokeshire lies north of a line joining Newgale and Woodstock and west of the foothills of the Prescelly Mountains. On the north and west it is bounded by St. George's Channel. It is undulating, sparsely-wooded country, 200-600 ft above sea level, with a small river, the Western Cleddau, flowing southwards to Haverfordwest and the sea. Fishguard, with its neighbouring harbour village of Goodwick, has a population of about 5,000, while the cathedral city of St. Davids in the extreme west has about 2,000 inhabitants.

Strongly influenced by the Gulf Stream, the equable climate gives summers that are seldom hot and winters that are generally free of snow and severe frosts. Rainfall varies from 35 inches on the coast to 50 inches on rising ground near the eastern boundary. Forty per cent of this rain falls between April and September.

Soils are mainly of Ordovician, Cambrian and Pre-Cambrian origin, medium to heavy in texture and sometimes with impeded drainage. They are generally low in phosphate and lime, and frequent fertilizer dressings are necessary to counteract leaching in the abundant rainfall.

The mild, damp climate favours grass rather than arable crops, and temporary and permanent grassland accounts for forty-three of the sixty thousand acres of crops and grass. On this grassland the stocking rate of cattle and sheep is one livestock unit on $1\frac{3}{4}$ acres. Milk production is the chief, often the only enterprise on most farms but there are some fairly large non-milk-selling mixed farms. Fifty-six per cent of the farms are in the 15 to 100-acre size group—mostly family farms with small dairy herds. A few large dairy herds of 100 cows or more produce summer milk on the paddock grazing system. Friesian is the predominant breed, with occasional herds of Ayrshires, Guernseys and Jerseys. Most cows are milked in cowsheds but as herd sizes tend to increase so do milking parlours, bails and loose housing. Where there is natural shelter from prevailing winds many herds are outwintered. Grass conservation is mainly as hay; silage enthusiasts are rare.

The beef herd is relatively small. Many dairy farms carry a few cross-bred animals for sale as stores or fat but the larger herds of beef cattle are confined to the more extensive mixed farms. Cattle are finished either on the abundant summer grass or in yards during winter.

Sheep, though not very numerous, are scattered throughout the district. The larger flocks are maintained mostly on the bigger mixed farms where they do not compete with dairy cows for spring grass. Ewes are usually dark-faced, indicating Suffolk ancestry, but lately Welsh and Scotch half-breds have gained a footing. Most of the lamb crop is sold fat off grass.

Pig and poultry enterprises are not well developed. Two farms have herds of a hundred sows or more, the progeny of which is fattened for bacon. The remaining sow population is thinly spread over numerous farms where they are kept mainly for the production of weaners, many of which are sold through marketing groups. Egg production and turkeys are sidelines on a number of farms, generally in small units, but one large unit breeds, rears and processes several thousand turkeys a year.

Most of the arable land is found within the 35 to 45-inch rainfall belt. Between St. Davids and Methry, where farms and fields are large by local standards, a substantial acreage of barley is grown. Here, as elsewhere, the newer varieties outyield the old, but on the more exposed farms growers do not choose very stiff-strawed varieties as strong winds at harvest time often cause quite heavy grain losses. Attempts are being made to grow barley continuously or with very short breaks but foot-rots, leaf blotch and mildew, which flourish in the humid climate, may militate against this. To obviate the need for grain drying, high-moisture grain silos are beginning to appear on the skyline.

On the St. Davids peninsula there is a considerable acreage of early potatoes, one arable crop that the climate does favour; some specialists grow from one to two hundred acres and many more grow from a few acres upwards. The bulk of the crop is planted from mid-February to mid-March and lifting generally commences towards the end of May, when yields of about three tons per acre may be expected. As the season progresses, yields may rise to ten tons per acre or more but the best profits are usually made at the beginning of the season. Though gross margins vary widely from year to year, most growers consider this crop to be a 'good gamble'. Some have constructed reservoirs and installed irrigation equipment to ensure a good supply of moisture during the month of May. Any deficiencies at this critical period can drastically reduce yields and profits. This enterprise has recently become more mechanized to counteract a dwindling supply of casual labour for planting and lifting. Early potatoes are usually followed by catch crops of rape, Italian ryegrass or mustard for stock feeding or ploughing in.

The coastline of the district has great natural beauty and most of it is designated as a National Park. Wild flowers, some rare, bloom in profusion. Sea birds, including the gannet, abound, and many migrant birds touch down for a brief rest before continuing their journeys. Atlantic grey seals haunt the quieter coves and caves. It is not surprising, therefore, that ever-increasing numbers of people come here for their summer holidays. These 'invaders' bring added prosperity and are more cordially received than were twelve hundred Frenchmen when they landed at Carreg Wasted Point, near Fishguard, on 22nd February, 1797, on what proved to be the last invasion of Britain.

J. L. MOORE

*Agricultural Land Service, Winchester*

# The Dutch Barn and Lean-to

A recent letter to one of the leading farming papers asked why the editor only printed articles about successful enterprises and never any about unsuccessful ones. The same sort of question could be asked about articles on farm buildings. There is always plenty to read about elaborate yard-and-parlour schemes, new types of piggeries, complicated grain stores and so on, but never a word about the ordinary Dutch barn and lean-to which, after all, exists on nearly every farm in the country. In particular, this type of building is found on the small farm, but nearly every farmer suffers from 'lean-toitis' to a certain extent. Most farmers on visits will tell you of their ideas for erecting a lean-to on some high building or other, which they have been dreaming about for years.

A Dutch barn and lean-to can, of course, form part of an elaborate yard-and-parlour scheme but more often than not it can be an isolated item of improvement. This means that a small farmer is glad to get all the advice he can on what may be the biggest decision on fixed equipment he has to take in his life. The advisory literature which is available to the farmer may not help him very much on the subject of lean-tos but the visiting A.L.S. officer, drawing on his wealth of experience, can give valuable and much appreciated advice on what may seem to be relatively simple matters.

Usually the size and siting of the building are the first considerations. As far as size is concerned, the points are obvious—this must be related to the size of the farm, yields, stocking, and so on. Siting must be thought about carefully to make sure that bulk feeds to be stored in a Dutch barn are reasonably convenient to other parts of the farm where they are to be used. If possible, it is best to site new buildings parallel, or at right angles, to existing buildings and, if they are of framed construction, to line up the bays with those of other buildings.

The next question that arises is the type of material to be used. The basic alternatives are concrete, steel and timber and their various permutations, some of which include all three types of material, e.g., concrete stanchions, steel main rafters and tanalised timber purlins. There is not a simple answer to this question, but most estates usually follow a policy of adopting a uniform specification and this seems to be the best advice that can be followed by the owner-occupier too. As far as merit and cost are concerned, there is not much to choose between the three materials. The concrete firms are well-known on a national basis and most areas have old-estab-

lished and reliable steel firms. There are firms specializing in timber-framed buildings but these tend to have a less wide coverage than the steel and concrete firms. In some areas local joiners will quote for Dutch barns and lean-tos, but their specifications can vary enormously and should be examined very carefully.

As the overall choice is much the same, it means that the final decision will often rest on the finer points. Care should be taken when comparing specifications to see whether or not the price includes the foundations, that the foundations are to be done in accordance with the British Standard, that the asbestos cement sheets are to be laid correctly with the requisite number of hook bolts or drive screws, and that two coats of approved paint are to be applied to the steel, and to check countless other but important matters of detail.

The normal victim of 'lean-toitis' usually thinks in terms of timber main rafters and purlins and covering with asbestos cement sheets. Often this results in the sheets cracking and the lean-to sagging in one direction, and probably both. The reason for this is that invariably the farmer has not appreciated the size and strength of the timber needed. With 15-ft bays, a 9 in. × 3 in. timber main rafter is only satisfactory up to a span of 10 ft and an 11 in. × 5 in. timber is needed for a 15-ft span. These farmers would, therefore, be well advised to consider using R.S.J.s for bigger spans.

The answer given by the editor of the farming paper to the correspondent who wrote asking why he did not print articles about unsuccessful enterprises was that he would very much like to if he could get anyone to come forward with this sort of story. There need not be anything unsuccessful about the lean-to. There are plenty of small farms, and even a number of big ones, where over the years lean-tos have been added wherever possible and in every shape and size. It is questionable, however, whether any of them have continued to be used for the purpose for which they were designed. Open-fronted cart sheds of days gone by have become anything from loose boxes to cowsheds. Some are satisfactory, but others, like Topsy, have 'just grown'. It can be an interesting exercise to examine the use to which lean-tos are put and to consider them in relation to other buildings, bearing in mind suitability for their correct function and labour economy.

It is hoped that this article has filled a small gap by touching briefly on some of the more important points that could profitably be considered by the prudent owner-occupier when thinking about erecting a Dutch barn—or when he feels an attack of 'lean-toitis' coming on!

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CORRECTION

**Tower or Clamp Silos?** (*J. N. Addison and E. H. Joce, January*, 1966, *issue*)

On page 3, under the heading 'Capital investment', the first sentence should read:

'The capital investment for silos and machinery on farms A and B was, respectively, £68 and £58 per cow unit.'

# Books

**Animal Anaesthesia. Volume 2.** WESTHUES and FRITSCH. Oliver and Boyd, 1965. 95*s*.

The second volume of Animal Anaesthesia, by Westhues and Fritsch, deals with the problems of general anaesthesia. It is complementary to Volume 1, which was concerned exclusively with local anaesthetic techniques.

The subject matter is covered under four main headings: the principles of anaesthesia; the drugs which are employed; the technique of anaesthesia; and its application to the different species, including birds and laboratory animals.

The section dealing with anaesthetic principles gives an excellent introduction to the physical and physiological basis of anaesthesia. It also considers the pre-operative and post-operative care of the patient as it concerns the anaesthetist and the factors which must be considered when choosing the ideal anaesthetic method for any given case. It might be argued that more space could have been devoted to physiology and less to the signs of anaesthesia, but the balance must be a matter of opinion.

Anaesthetic drugs are dealt with in groups according to their actions and uses. This section is extremely comprehensive, reading more like a pharmacopoeia than a text-book, and covers so many drugs that it is rather overwhelming to all but the discriminating expert.

All the common techniques, from intravenous injection, intubation, inhalation and artificial respiration, are described in detail in the section dealing with anaesthetic technique. In addition, the common anaesthetic complications and emergencies are discussed, together with the less-well-known techniques of hypothermia and electrical anaesthesia.

The final section is devoted to the application of anaesthetic techniques to all the common domestic animals. There is also a section dealing with anaesthesia of wild animals, both free-living and in captivity, and of laboratory animals, birds, reptiles and fish. Much of this section involves repetition of the earlier parts of the book, but there is no doubt that it provides most useful information should the reader be called upon to anaesthetize an unfamiliar species.

The production of the book is of an extremely high quality. The type is excellent, the drawings are clear and well-positioned in relationship to the text, and most of the illustrations can be examined in detail. Not all of the equipment or methods which are shown are familiar in this country, but that is no reason to disregard them. There is an extensive bibliography.

The translation of both volumes has been carried out with great skill by Dr. A. David Weaver, to whom considerable credit must be given.

*R.G.W.*

**Food Technology the World Over. Volume 2. South America, Africa and the Middle East, Asia.** Edited by MARTIN S. PETERSON and DONALD K. TRESSLER. Avi Publishing Company, Westport, Conn., U.S.A., 1965. $15.

The chapters of this book have been written by sixteen separate authorities and naturally there is some unevenness of treatment. This is due not only to the differing authorships but to the availability of information from different areas. The majority of the chapters were specially written, but three of them and an appendix on Communist China are reprintings of previously published works.

The work begins with a useful chapter by Dr. Peterson on the 'resources of the technical literature' available as a background to the establishment of a modern food industry. This includes simple descriptions of the main methods of food processing and indicates where the relevant literature can be found. As might be expected of the author, the approach is widely based, starting with a brief discussion on the general problem of industrialization and its pertinent literature.

A theme of the book, and particularly of Dr. Peterson's chapter, is that an industrialization programme for a developing country must take into account the resources of that country, both natural and human. Usually the first need is the assessment of the native resources of the land and the talents and skills of the people and the use of these wherever possible in

the process of changing the old order for the new. An asset of profound importance in the development of an industry is the availability of an adequate number of well-educated technologists and engineers, and this is as true for the food industries as for others. These technologists need to be trained in technological teaching centres of all levels preferably in the countries in which they will work.

The bulk of the book deals with individual areas in turn. These are Brazil, Tribal Africa, Egypt, Israel, Communist China, Nationalist China, India, Philippines and Japan. Each chapter contains in more or less detail an account of agricultural production in the area, the local methods of food processing and preservation, together with useful and interesting information on food habits and the nutritional adequacy of the diets.

It is impossible to summarize here the large amount of information given, but it is evident that tribal communities may not be as short of food as one has thought. However, as soon as the family or tribal organization is disrupted by the beginnings of industrialization, then food wastage increases acutely unless modern knowledge is applied to the problems of preservation and transport. This application is likely to be most effective in the first instance if made at village level to simple methods of processing, many of which are well described in this book. But sooner or later, with increasing industrialization and urbanization, full use of modern scientific knowledge and technology is needed not only to increase the productivity of the lands and waters but, equally important, to create an efficient food industry.

Table 1 lists some of the technical assistance agencies, their addresses and the monetary, educational or consultative aid that they can provide.

*H.R.B.*

**A Forest by Night.** F. J. SPEAKMAN. G. Bell and Sons, 1965. 18*s.* 6*d.*

Quite close to the A.11, a few miles south-west of Epping Town and twelve miles from London, the author spent some days and many nights in the forest every month from January to December, 13 or 14 years ago. He has an easy, gentle style, when describing the trials and rewards of sitting alone in a tree night after night—insect-bitten in the warmer months and snow-covered in winter—listening and sometimes seeing the coming and going of a hunting fox, a badger or a tawny owl. I shall remember his account of a little sow badger leaving her sett on a foraging expedition in the midst of a December storm when 'Winter's arm is wrapped about each tree'. Although badgers are among his favourite companions, he has time also for many other species; the shrews that 'rush hither and thither burning out their little lives', a hedgehog eating adders, or the behaviour of fallow does and their fawns.

Spending so many hours in a sometimes eerie solitude, at night, it is not surprising that the writer should be aware of his separateness from more diurnal men. This leads at times to smugness but more often to serene philosophizing, as when commenting on the dawn chorus: 'Sunrise and sunsets may be but damp and dust, and song but sex, but man has an appreciation that can accommodate both science and beauty.'

It is regrettable that, with considerable opportunities, the author's photographic efforts ended so frequently in minor disaster, but it is clear that for him the observations were of so much more interest than the recording.

Mr. Speakman is primarily a naturalist, who pleads persuasively for wildlife conservation. He is inclined to emotional judgments and has an ear for the fanciful, but although his book does not add greatly to existing knowledge of wildlife, he has made personal observations and describes them with charm.

*H.V.T.*

**The Relative Importance of Certain Factors in Profitable Milk Production.** V. H. BEYNON and J. A. LANGLEY. University of Exeter Department of Agricultural Economics. Report No. 154. June, 1965. 3*s.* 6*d.*

The objectives of the study which forms the subject of this report were to assess the influence of certain factors in profitable milk production—density of stocking, milk yield per cow, price per gallon and concentrate and fertilizer usage—and to rank them according to their relative importance. This is, therefore, a statistical exercise which attempts to unravel the

very variable production conditions and profitability of 67 dairy herds in the south-west in 1960/61.

As such it is to be welcomed, for far too many reports on dairy farming show the average results of groups of farms sorted according to one characteristic at a time, while other characteristics are allowed to vary in an uncontrolled way; the resulting imprecise answers being then clothed in carefully imprecise language. It is still not clear, however, whether the present method of analysis is completely free from fault, since it is based on a selected sample. Although it is true that Channel Island herds have been excluded from the analysis, other characteristics (such as quality of management, land and labour) have not been controlled or measured. This may account for the fact that diminishing returns were not found to occur.

The study is based on the concept of gross margins, and gross margin per acre is chosen as the dependent variable. Such an approach makes the conclusions particularly relevant to small farms and other situations where land is limiting, but it will not always produce the right answer where capital or labour are the limiting factors. A careless use of gross margins could also produce erroneous conclusions where a lower gross margin per acre could be more than offset by lower overheads.

Within these limitations, the authors have made an authoritative and well-explained analysis of the data, and have shown that gross margin per forage acre is mainly determined by gross output per forage acre, which in turn relies heavily on output of milk per forage acre. Going further, the authors show that density of stocking explains the largest portion of the variation in output of milk per acre. The price of milk is the least important of the factors studied. An important conclusion is that density of stocking may be increased to advantage without accompanying changes in other factors, i.e., that there was under-utilization of resources on these sample farms. Anyone who casts a critical eye over much of the grassland in England and Wales cannot fail to accept this finding.

Much of what is contained in this report could perhaps have been predicted by an experienced dairy economist or adviser, but it is important to substantiate hunches, particularly if at the same time a useful quantitative assessment can be made of them.

*G.H.W.*

**Experimental Pedology.** Edited by E. G. HALLSWORTH and D. V. CRAWFORD. Butterworth, 1965. 85*s*.

*Experimental Pedology* is a record of the proceedings of the eleventh Easter School in Agricultural Science, organized in 1964 by the University of Nottingham. For those unfamiliar with the word, pedology means 'the science of the study of soils', regarding soils as natural bodies and excluding applications of soil science to crop production and economic farming.

Pedology has developed from studies of the influences of climate, topography, parent material, vegetation, fauna and micro-organisms on soil conditions and soil formation. Using observation and techniques of examination borrowed from other sciences, it has provided much information on the formation, composition, structure and history of soils which has been used as a basis for soil classification and soil survey and to improve understanding of physical, chemical and biological processes occurring in soils. This information has also been usefully applied to land use and the treatment of soils to make them suitable for particular crops and farming systems.

Experimental techniques to ascertain the processes by which soil conditions are formed had to wait until the nature of soil profiles had been established, by much patient field and laboratory work, and indications obtained of the sequence of changes occurring in soil profile development and of the time taken for each stage to be reached. Recent advances in other sciences, particularly in structural chemistry, physical chemistry, geochemistry and biochemistry, have provided a range of new techniques for studying the structure of materials, reaction mechanisms, recognition of products and for following the effects of accumulation and movement of products. These techniques have been used to simulate weathering and other soil-forming processes and bring them under control and measurement. This is what experimental pedology sets out to do.

The present book contains a series of 29 papers consisting of reviews and original contributions on geochemistry and weathering of soil minerals; redistribution of inorganic substances in soils; biological aspects of soil formation; studies in pedogenesis; and demonstrations of techniques and methods. They are written for people with special interests in these fields of study and require a fair background of soil science to appreciate their significance and value. The papers were contributed by soil scientists from the United Kingdom, Australia, New Zealand, the Netherlands,

France, Germany and Israel, and are all of high technical quality.

*Experimental Pedology* is a worthy addition to the proceedings of previous Nottingham Easter Schools and to the literature of soil science. The editors are to be congratulated on its quality and for bringing it out only a year after the papers were presented.

*N.H.P.*

**Traditional Country Craftsmen.** J. GERAINT JENKINS. Routledge and Kegan Paul, 1965. 45*s.*

There have been many books written about rural craftsmen and their work, and when yet another is published one tends to read it with a critical eye to discover whether it is really justified. The tests must surely be whether the author has contributed anything new to a knowledge of the craftsmen's tools and processes or added anything to the historical record of the past.

Perhaps the first thing to strike one about this book is that it is written by a professional. Mr. Geraint Jenkins was brought up in Cardiganshire where, probably because of its isolation from the main industrial areas, many rural crafts survived longer than in most counties. Even today Cardiganshire boasts three working woollen mills, and the ancient art of coracle making is still practised there. Mr. Jenkins has been on the staff of the Museum of English Rural Life at Reading, and is now Assistant Keeper at the Welsh Folk Museum at St. Fagans, near Cardiff.

This is not a book of nostalgic reminiscence but a serious and well-written work which is likely to become a standard history of the many crafts and skills with which it deals. There are descriptions of the tools and processes used in thirty-five different crafts, and no less than fifty-four line-drawings and a hundred and eighty-five excellent photographs to illustrate the text. Even so, I was disappointed to find that there are some notable omissions from the crafts described, for example, the woodman, hedger, ladder-maker, cider-maker and windmiller.

Mr. Jenkins's work is likely to give pleasure and instruction not only to those who live among, or already possess a knowledge of, rural craftsmen, but also to the many people who know of their existence only through trips to the country or visits to agricultural shows.

*R.W.S.*

**Practical Land Drainage.** TURNER COOPER. Leonard Hill Books, 1965. 25*s.*

Field drainage has, in the past, been based largely on tradition and experience, and much of the experience and 'know-how' of so many eminent practical drainers has been lost with their deaths. It is, therefore, very pleasing to find one such person who has taken the trouble, as stated in his preface, to record his experience so that any knowledge gained can be handed on to the next generation.

There are five sections dealing, respectively, with basic information on drainage, old drainage systems, tile drainage, mole drainage and special situations such as gardens and sports fields. It is illustrated by line drawings.

The book is interesting to read although, as expected in the circumstances, the author occasionally finds difficulty in expressing his ideas clearly and is inclined to repeat himself. Many of the ideas he puts forward are controversial and would lead to endless argument in any discussion. Some are contrary to accepted good drainage practice.

Fortunately it is made clear that the book is not intended as a 'treatise for the experts', for as such it leaves much to be desired. On the other hand, as the record of the experience and practical tips of one drainage expert, it is very good, and as background reading for the student it can be recommended. Whatever the use or opinion of the book, Mr. Cooper must be commended for taking the trouble—and trouble it must have been—to write it, and his son for having it published.

*G.H.T.*

**The Biology of Viruses.** KENNETH M. SMITH. Oxford University Press, 1965. 12*s.* 6*d.*

In writing *The Biology of Viruses* the author has tried 'to preserve something of the romance of scientific research which is so often bogged down in too much technical detail'. This has been largely achieved by confining the text to carefully selected highlights of research on which current knowledge of the biology of viruses is based, rather than attempting a comprehensive review of an extensive subject.

The book is in two main sections. The first deals with viruses of plants, bacteria and insects; the second, with those of man and the higher animals. Among the plant viruses discussed are tobacco mosaic virus and turnip yellow mosaic virus, both of which have been the subject of intensive research which has contributed much to present knowledge, particularly of the fine structure and chemical nature of plant virus particles. Chapters are devoted to the important groups of plant viruses transmitted by aphids and leafhoppers and relationships of these viruses and their vectors are reviewed. In addition to insects, other recently-discovered vectors, such as free-living soil eelworms and root-infecting fungi, are described in relation to the methods of transmission and the viruses involved. The interesting group of bacterial viruses, the phages, are described with particular reference to their development, structure and infection process. The chapter on insect viruses covers the types of particle involved, the location of the virus in the insect host, and the histological and pathological effects of infection.

The second section reviews current knowledge of viruses of the higher vertebrates, and these are classified on the grounds of chemical composition, size, shape and relationships with the host cell into the main groups *Pox viruses*, *Herpesviruses*, *Myxoviruses*, *Arboviruses* and *Picornaviruses*. A concluding chapter describes some of the tumour-forming viruses of vertebrates including *Polyoma* virus, the discovery of which stimulated the renewal of the search for a virus as the causal agent of human cancer.

This little book is presented in a most lucid and absorbing way, and the treatment of the subject matter is a true reflection of the author's wide knowledge of the subject.

*R.H.C.*

**Books Received**

*Annual Report on Animal Nutrition and Allied Sciences. Vol.* 21, 1965. Rowett Research Institute. 10*s*. (including postage).

*Agricultural Mechanization*. Mechanization of the Cultivation of Peas. Economic Commission for Europe. United Nations, New York, 1965. $0.35.

*People in the Countryside*. Studies in Rural Social Development. (A Report based on the work of the United Nations European Study Group). Edited by John Higgs. 1966. The National Council of Social Service, 26 Bedford Square, London, W.C.1. 20*s*. (by post 22*s*.).

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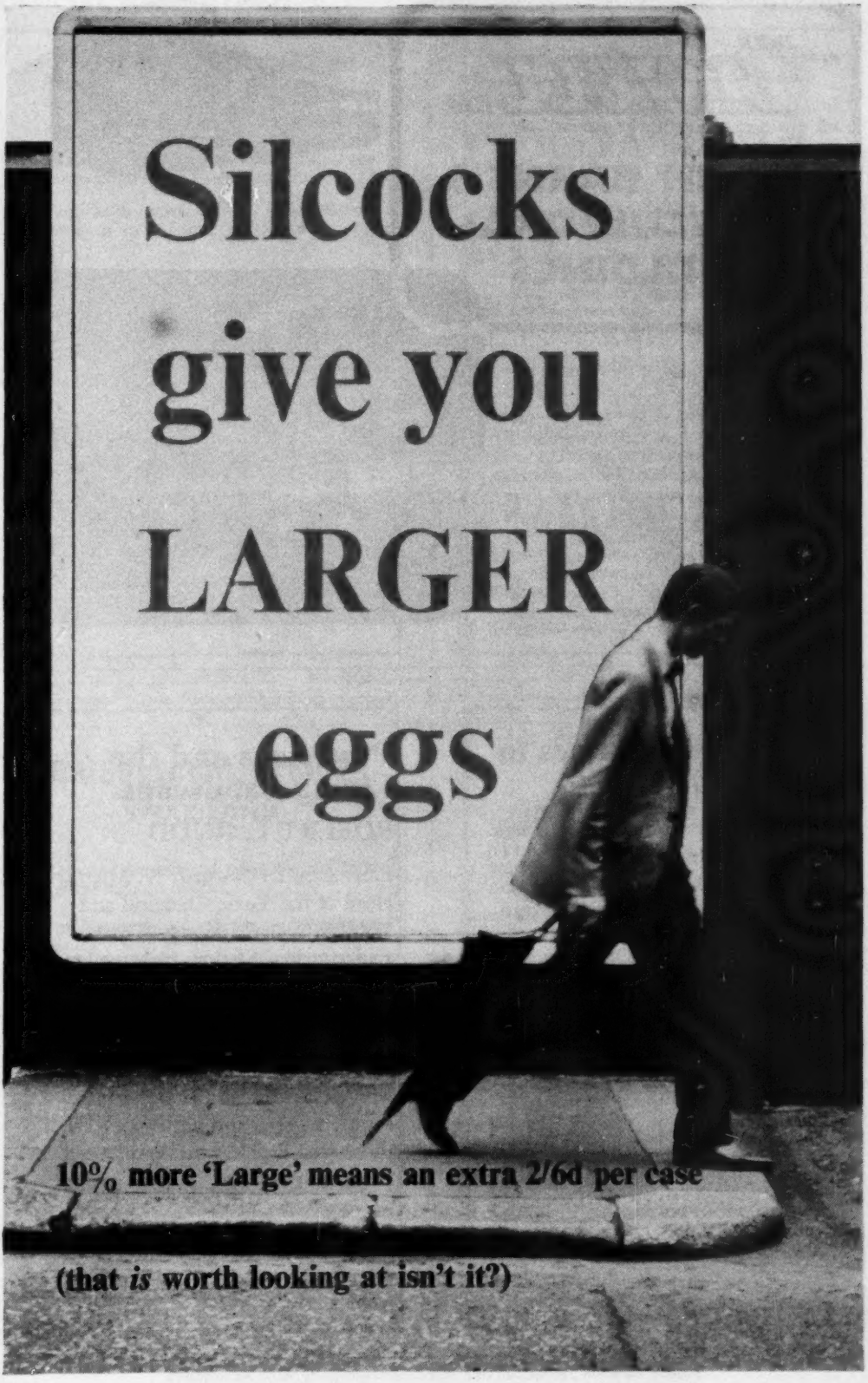
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### UGANDA

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Salary £2,100 to £2 500 a year (according to qualifications and experience) subject to British income tax, plus a variable non-taxable foreign service allowance of £525 (single) £820—£900 (married unaccompanied) and £970—£1,085 (married accompanied) a year. Education allowances. Passages provided. Quarters available. Two-year contract.

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### LIVESTOCK IMPROVEMENT OFFICER
### KENYA

Applications are invited for the post of Livestock Improvement Officer to supervise the breeding programme of the National (Sahiwal) stud and to carry out field trials and research in nutrition and management under the direction of the Chief Veterinary Research Officer.

Candidates who should normally be nationals of the United Kingdom or Republic of Ireland should possess a degree in veterinary science or an honours degree in agriculture, with extensive experience in livestock breeding and animal husbandry.

Salary in scale £1,374 to £2,757 per annum (entry point determined by qualifications and experience) plus 25% terminal gratuity. Free passages. Quarters available. Two-year contract.

Please apply for further details giving full name, qualifications, experience and quoting Ref. RC 217/95/012 to:

Appointments Officer,
Room 301,
MINISTRY OF OVERSEAS DEVELOPMENT,
Eland House, Stag Place,
London S.W.1.

WOLVERHAMPTON TECHNICAL TEACHERS' COLLEGE

## TRAIN FOR A CAREER IN TECHNICAL TEACHING

***Agriculture and Horticulture***

Applications are invited from those with good experience and between the ages of 25 and about 45. (Graduates under the age of 25 may be considered) for the next one-year full-time course of teacher training which would enable them to take up **FULL-TIME TEACHING APPOINTMENTS IN AGRICULTURAL AND HORTICULTURAL SUBJECTS in establishments for further education**

**Next course: September 1966 to June 1967**

Applicants should possess suitable qualifications such as a university degree or National Diploma. Successful completion of the course gives Qualified Teacher Status under Department of Education and Science regulations

**FREE TUITION**
**MAINTENANCE GRANTS AVAILABLE**

For full details and application form write to:
The Principal (S.53), Wolverhampton Technical Teachers' College, Compton Road West, Wolverhampton, Staffs.